Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVIII. No. 17. NEW YORK, SATURDAY, APRIL 27, 1901. ISSUED WEEKLY.

ELECTRICAL REVIEW

Park Row Building,
13-21 Park Row, New York.
P. O. Box 2339.

By the
ELECTRICAL REVIEW PUBLISHING CO.

CHARLES W. PRICE,
President and Treasurer.

STEPHEN H. GODDARD,
Secretary.

Registered Cable Address:
"Electview," New York.
Telephone Call, 21 "Cortlandt."
(Private branch exchange connecting all departments.)

Western Office:
1612-1613 Marquette Building, Chicago.
London Office:
42 Old Broad Street, London, E. C.

Subscriptions to the
ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - - 5.00
Single Copies, each, - - - - - - - - .10
Copies can be supplied for only one year back at 25 cents each.

To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

CONVENTIONS.

Next month is the convention month. The most interesting meeting to the worker in the electrical field that will be held in it is the annual gathering of the National Electric Light Association, which will occur at Niagara Falls on May 21, 22 and 23.

Since the last meeting of this association there have been marked improvements made in the direction of central station economy, in methods of operating public lighting over extended areas, in appliances and apparatus for electric lighting and discoveries and inventions which bid fair to exert no little influence on the future of the industry. For this reason, as well as on account of the excellent programme of papers which has been prepared, it is believed that this year's meeting will be one of the most interesting in the history of the association.

WHAT DOES A CENTRAL STATION SELL?

There has been comment before in these columns upon the universal practice of charging the customers of electric lighting central stations for electricity rather than for light. This custom is, of course, one that has grown up naturally and developed with the general development of the art, so that to-day there are in use a number of more or less complex systems of charging founded upon an attempt to secure an equitable and just basis for both consumer and manufacturer of electricity. If there were no hope that improvements might be made, and if the art of constructing translating devices which change electrical energy into light were thoroughly worked out, the ease with which current can be measured would make the practice of charging for electricity as the delivered commodity one against which no objection could be made. But, fortunately for the art, though somewhat unhappily for central station managers, there are apparent various directions in which improvements may be made in the translating apparatus with the result that the consumption of electricity to produce a given light in a given district will, in the future, possibly be materially reduced.

It is probable that the fair general average of incandescent lighting in this country is done on the basis of about three and one-half watts per candle-power. The Nernst lamp, which is rapidly being developed, threatens to cut this consumption of current in half, while the hope for vacuum tube or some other highly efficient form of light is daily receiving food in the shape of results achieved by a dozen experimenters. With the commercial situation as it is it seems inevitable that improvements in electric lighting may perhaps reduce the profits of electric lighting companies.

This condition of things would not long be tolerable, but no one who admits the possibility of great improvement in electric lighting devices can fail to see that an increase of efficiency in lamps will mean, for the same amount of light, a decrease in current output at the station, and hence a decrease in the revenues of that institution. The benefit of the more efficient lamp will be for the customer, not for the producer; and, though the cheapening of light that must result from such a state of things will doubtless cause a considerable extension of its use, it seems reasonable now to discuss an arrangement whereby both the customer and the station would receive benefit from improved apparatus and at the same time the use of electric lighting be considerably extended.

Let us assume a hypothetical case, and conceive that a lamp, suitable for use in the ordinary fixture and replacing the incandescent lamp, is devised so efficient that it would require one-half the current now used to give the same light. The effect of its general introduction into the area fed by a given station would be to reduce the output of the station by one-half and thus to cut the consumer's bills in two while giving him the same amount of light that he has under the present régime. Doubtless the consumer would be highly pleased, but unless the station is able, immediately, on the strength of the cheapening of light, to connect enough new lamps to double its total supply, the electric light company would find its revenues falling off and the only compensation a small reduction in running expenses on account of the decreased output.

On the other hand, if customers were paying for light and not for electricity the bills after the change of lamps would remain the same and the revenues of the station would remain the same, while its expenses would be somewhat decreased. This, again, is an inequitable arrangement and bad business policy, for the reason that the customer gets none of the advantage of the change and that extensions of the business would be as difficult

as before. If, however, the customer were charged for light, and the charge was made upon some basis depending upon the cost of producing the light, then the effect of new lamps and other inventions would be to decrease the customer's bills without at the same time decreasing the revenue of the company. It is entirely evident, however, that, so long as current is charged for, the introduction of an efficient lamp will actually be a blow to the lighting companies. Looking a little further, it is evident that with customers paying for light, and the price of light growing less with each invention that makes electric lighting cheaper and better, there would soon be only one illuminant in general use in cities. Electric light would have its field to itself and be without a rival in popular use.

It may sound like a step backward to advocate a return to the old system of charging so much per lamp-hour, but it seems demonstrable that this is the most equitable method of charge and the one likely, in the end, to supplant all others. After all, what the customer buys and pays for is light. The average consumer of electric light does not know what a kilowatt-hour is and probably will never learn. He pays his bills with the usual feeling that he is being robbed because of mysterious looking meters and outlandish expressions with which he is not familiar. But what he pays for is light, not kilowatts. What the electric light company sells him under the present condition of things is electrical energy and not light.

It ought not to be particularly difficult to measure light-hours or candle-power-hours by meters especially constructed to read in these units. The same system of charges, based on maximum demand and time of demand, that is already working so successfully may be applied equally as well to the new basis of computation. The price charged should be kept low enough to discourage competition and extend the use of electricity for lighting, while yet high enough to guarantee a safe and remunerative profit to the station. That this can be done when charges are made for the light delivered seems evident enough; that it can not be done when charges are based upon electrical energy delivered seems equally evident to any one who notes the success that is attending experimental work in the direction of producing a higher efficiency in electric lamps.

INCANDESCENT VAPOR LIGHTING.

On other pages of this issue will be found a description of the very interesting method of electric lighting devised by Mr. Peter Cooper Hewitt. For a number of years experimenters have worked in the direction of producing cold light—that is to say, of transforming electricity into light without at the same time wasting much of the energy employed as radiated heat. It has been known for a long time that lamps of high efficiency might be made, using the ordinary carbon filament; but that to attain a large proportion of production of visible radiation, or light, the filament would have to be worked at a temperature so high as to shorten its life beyond commercial limits. Numerous attempts have been made of late to replace the incandescent filament of carbon with other things, the most notable success probably having been obtained by Dr. Nernst, who uses refractory oxides heated to intense incandescence by the passage of the current. Even these lamps, however, by no means attain ideal perfection, since a very large proportion of the total radiated energy coming from them is evident in the shape of heat and not as useful light, and it can be demonstrated that the highest efficiency can never be attained with high-temperature sources of light.

After much experiment along other lines Mr. Hewitt hit upon the simple expedient of using a metallic vapor enclosed in a glass tube as his conductor, and set out with the enthusiasm and thoroughness of the true scientist to discover first the laws which govern the phenomena of conduction under such circumstances. His discoveries in this direction are of deep interest and at the same time rather calculated to astonish those who have not closely followed recent investigation as to the nature of attenuated gases and of electrical phenomena taking place in them. The results he has attained, while by no means commercially perfect, are certainly highly interesting and such as to arouse strong hopes for the ultimate perfection of an exceedingly efficient system of lighting along these lines. At present the lamps of this system, while giving forth powerful and steady light, are handicapped by the peculiarly disagreeable color of the light emitted. It does not seem difficult to correct this defect. Certainly the effort is worth making, for the efficiency already attained is nearly ten times as high as that of the ordinary carbon filament incandescent lamp, and with this is coupled great certainty and steadiness of working.

It is too early yet to indulge in any speculations as to the industrial outcome of the interesting researches which Mr. Hewitt has conducted, but they certainly merit careful attention, and the beauty and brilliance of the phenomena, together with the simplicity of the apparatus and methods employed, make them of peculiar interest at this time.

A good many people who subscribe to technical journals and have their papers bound at the end of the volume make a practice of throwing away one of the most interesting parts—the advertising pages. The average bound volume of a journal contains only the letter-press and illustrations that go to make up the reading part. The advertisements are ruthlessly discarded when the book is bound, and with them is thrown away one of the most truthful and interesting of pictures of the state of the art at the time.

In looking over old files of the ELECTRICAL REVIEW, in which the advertisements have been preserved equally with the reading matter, one is struck with the curious fact that he has to look back through only a short vista of years to find the advertising columns even more interesting and entertaining than those devoted to reading matter only. Going back through the pages of old volumes of a technical publication, in which the wise plan of preserving the advertising pages has been employed, one soon begins to lose interest in the reading matter itself in favor of the advertisements. Some of those of fifteen years ago, for example, are to-day of deep interest, since many times they establish the date of introduction of some important improvement, furnish material for history and give a sort of continuous picture of the progress of the electrical arts.

I. H. Farnham Killed.

Tuesday afternoon, April 23, while Mr. I. H. Farnham, of Boston, chief electrician of the New England Telephone Company, was superintending some alterations in the Portland, Me., telephone exchange, George Brainerd, the foreman of the work, who had been with the company 20 years, suddenly became insane and shot Mr. Farnham, killing him instantly, and also shot three of his fellow workmen—E. M. Buxton, who is thought to be fatally wounded; James Wadsworth, who escaped with a flesh wound, and Elmer Lane, who is now lying in a critical condition. Mr. Farnham has been well known for many years in telephone work, and leaves a widow and one child.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXIV.*

BY W. ELWELL GOLDSBOROUGH.

The presentation of the phenomena induced by the presence of constant and multiple valued reactances in the same series circuit is not complete unless the influence of a constant capacity reactance upon a variable series reactance is discussed.

Cases of this kind are less frequently met with in engineering practice than those involving constant inductance factors, but from the theoretical standpoint they are none the less interesting.

In Fig. 65 there is diagrammed an alternating-current system consisting of two circuits. The first, OA_1, consists of a condenser of *variable* capacity connected in series with a constant resistance. The second circuit contains simply a condenser of *constant* capacity. The system has impressed upon it a constant electro-motive force from the alternator E of constant frequency. We have then for consideration the cycle of events that will take place in the circuit when the value of the capacity of the condenser C_1 is varied from zero to infinity.

When the capacity of C_1 is zero the reactance of the first circuit will be very high and will approximate the value of the impedance of the system. In this event the current flowing will be very small but will take a phase position 90° in advance of the impressed voltage. Imagine now that C_1 is considerably increased in value. The total reactance of the system, due to C_1 and C_2, will by this increase be much reduced, and a current OB_1, Fig. 67, will result.

In Fig. 67, OA is equal to E, the impressed voltage; and under the present assumed conditions, $OC_1 = I\,r_1$, the resistance electro-motive force of the circuit OA_1; $C_1A_1 = I\,x_1$, the reactance electro-motive force of the circuit OA_1; and $A_1A = I\,x_2$, the reactance electro-motive force of the circuit A_1A. We have, therefore, that C_1A is the total reactance electro-motive force developed in the system, and that OA_1 is the electro-motive force apparent at the terminals of the circuit OA_1.

Now if C_1 is gradually increased still further there will be a gradual reduction in the total reactance of the system; and Fig. 65, taken as a whole, will represent simply a circuit containing a constant resistance in series with a variable reactance. Therefore, as shown in Fig. 67, the current will gradually increase in value and come more nearly in phase with E, since its vector head B will follow the locus circle B_1, B_2, B, as C_1 increases. The maximum value that C_1 can attain is *infinity*, and if it reaches this value its power as a reactance factor will vanish. Under such circumstances C_2 offers all the reactance that is apparent in the system, and its vector will assume a position CA, such that, with OC and OA, it completes the electro-motive-force triangle of the system.

The reactance electro-motive force E_2, due to C_2, varies in value with the value

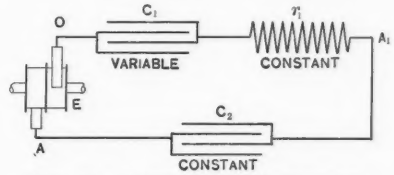


FIG. 65.—ALTERNATING MECHANISMS.

of the current, since C_2 is a constant; moreover, it has a phase position 90° in advance of the current at all times, therefore, as C_1 increases from a zero value, the locus of the vector of this reactance electro-motive force is the circle AA_1C, which cuts the resistance electro-motive-force locus circle OC_1C at the point C.

Now, since this reactance electro-motive force E_2 is the pressure that is apparent at the terminals of the condenser circuit A_1A, Fig. 65, it is one of two components of the impressed electro-motive force; the second component being the electro-motive force E_1, which appears at the

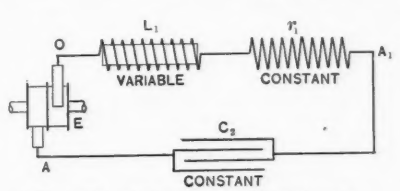


FIG. 66.—ALTERNATING MECHANISMS.

terminals of the circuit OA_1. Fig. 67 shows that this electro-motive force, $E_1 = OA_1$, has initially a value equal to OA the impressed electro-motive force; then, as C_1 increases, it rapidly diminishes and takes a position in advance of OA. Finally it passes a minimum value when its vector head is just to the left of A_1, and thereafter gradually increases until $C_1 = \infty$. When this occurs E_1 equals and coincides with $I\,r_1$, since $x_1 = 0$.

As E, r_1 and C_2 are constants, after C_1 reaches an infinite value, no further change can be made in the value of the current unless a variable inductance is introduced. Fig. 66 shows the circuit modified by this step. When the inductance L_1 is first introduced its value is very small. It, however, induces a reactance electro-motive force $I\,x_1$, that opposes the reactance electro-motive force $E_2 = I\,x_2$, and thereby diminishes the resultant reactance of the system which equals

$$x = x_2 - x_1.$$

Now a reduction of the reactance of the system below the value of x_2 causes the points C and B to move up towards the vector OA, along their respective loci, and eventually to coincide with OA, when L_1 has so increased as to make

$$x_1 = x_2$$

and

$$x = x_2 - x_1 = 0.$$

When $x = 0$,

$$I\,x_2 = I\,x_1$$

or the reactance electro-motive force of the first circuit OA_1 is equal to that of the second circuit A_1A, Fig. 66. These electro-motive forces are shown in their vector positions as AA_2 and A_2A, respectively. They are drawn through A at right angles to OA and are equal in length to the diameter of the locus circle $AA_1CA_2A_3$.

The condition of zero effective reactance in the system is a condition of resonance. At this time the current has its maximum value OB_2, since E is acting on what is practically a non-reactive system. The vector diagram OAA_2 is, therefore, similar to the diagram of Fig. 38, on page 183, already cited as illustrating a resonant effect.

To produce a lagging current in the system the inductance must be increased until x_1 overbalances x_2, and the system as a whole becomes inductive. If the increase in L_1 is marked enough the current may even assume such a lagging position as OB_3. In this case, since E_2 is proportional to I and at right angles to it, E_2 will take the position A_3A. Correspondingly the inductive reactance electro-motive force will have a value equal to C_3A_3, since it must be great enough to close the electro-motive-force polygon C_3OAA_3.

The condition of resonance exhibits an electro-motive force at the terminals OA_1 equal to the vector OA_2, but the last case shows that the electro-motive force at the terminals of the circuit OA_1 is much greater than OA_2. It is equal to OA_3, and is much in excess of E, although the current is less than when the resonant condition was prominent. This local increase in the pressure has already been shown to be not objectionable when properly controlled, and when so controlled may be used to very material advantage.

In Fig. 63 a phase diagram was shown that is quite similar to Fig. 67. In it the effect of a varying reactance upon a

* The present installment of Professor Goldsborough's article was omitted from its proper place—immediately preceding the installment published April 13—on account of an accidental loss of the engravings accompanying it.

system containing a *constant inductance* was illustrated, and the fact prominently brought out that a suitable adjustment of a *capacity in the system* would cause local increase in the pressure above that of the source. In Fig. 67 is illustrated the fact that in a system containing a *constant capacity reactance*, a local increase in pressure above that of the source is brought about by a suitable introduction of an *inductance into the system.*

The latter case, as already stated, is much less likely to be met with in commercial practice than the former. It is specially interesting because it is the graphical representation of the formula

$$I = \frac{E}{\sqrt{r_1^2 + \left(\frac{1}{C_2\,\omega} + x_1\right)^2}} \qquad (188)$$

in which E, r_1, ω and C_2 are constants; and x_1 is varied from $+\infty$ to $-\infty$.

During this change "B" passes around the circle $B_1BB_2B_3$ from O to O, "C" passes around the circle $C_1CC_2C_3$ from O to O, and "A" passes around the circle $A_1CA_2A_3$ from A to A, as indicated by the arrows in Fig. 67.

Science Brevities

Photography by Phosphorescence—In an interesting communication to *Nature,* Mr. F. Jervis-Smith says: "In certain libraries there exists a fixed rule that no books may be removed. This being so, all extracts and copies of plates and engravings have to be made in the libraries. Reproduction by the methods of ordinary photography is most inconvenient, since the employment of artificial light is strictly prohibited; also the introduction of a camera and its manipulation in a library, are surrounded by many difficulties. These circumstances led me to devise the following method for obtaining copies of plates, engravings, printing and writing. A piece of cardboard is covered with a phosphorescent substance, and after sufficient exposure to the light of the sun or of an arc lamp, it is placed at the back of the engraving or writing to be copied; on the face of the engraving or writing a dry photographic plate is placed, and then the book is closed for a certain time, depending on the nature and thickness of the paper used in the book. I find that the period of time lies between 18 and 60 minutes. The plate is then withdrawn and stored in a dark box for development. The dry plate is easily manipulated under a cloth, which shuts off all light and covers the book during the operation. The results are sufficiently good for most purposes—in the case of some papers the fibrous structure is shown; this very slightly detracts from the clearness of the copies made by this process. Neither the luminous substance nor the dry plate injures the book in any way, so that the method may be employed in the case of valuable prints and engravings. If films be used instead of plates, a large number of copies of different engravings in the same book may be made at the same time. The time of exposure to the phosphorescent backing is shortened considerably by placing the phosphorescent card on a warm surface, such as that of a metal vessel heated to about 20 degrees centigrade with hot water; when films are employed this temperature should not be exceeded. In an experiment made in the laboratory I found that the phosphorescent substance under normal barometric pressure became brightly luminous when subjected to the brush discharge of a Tesla inductor; the discharge from an ordinary induction coil fails to produce the same effects."

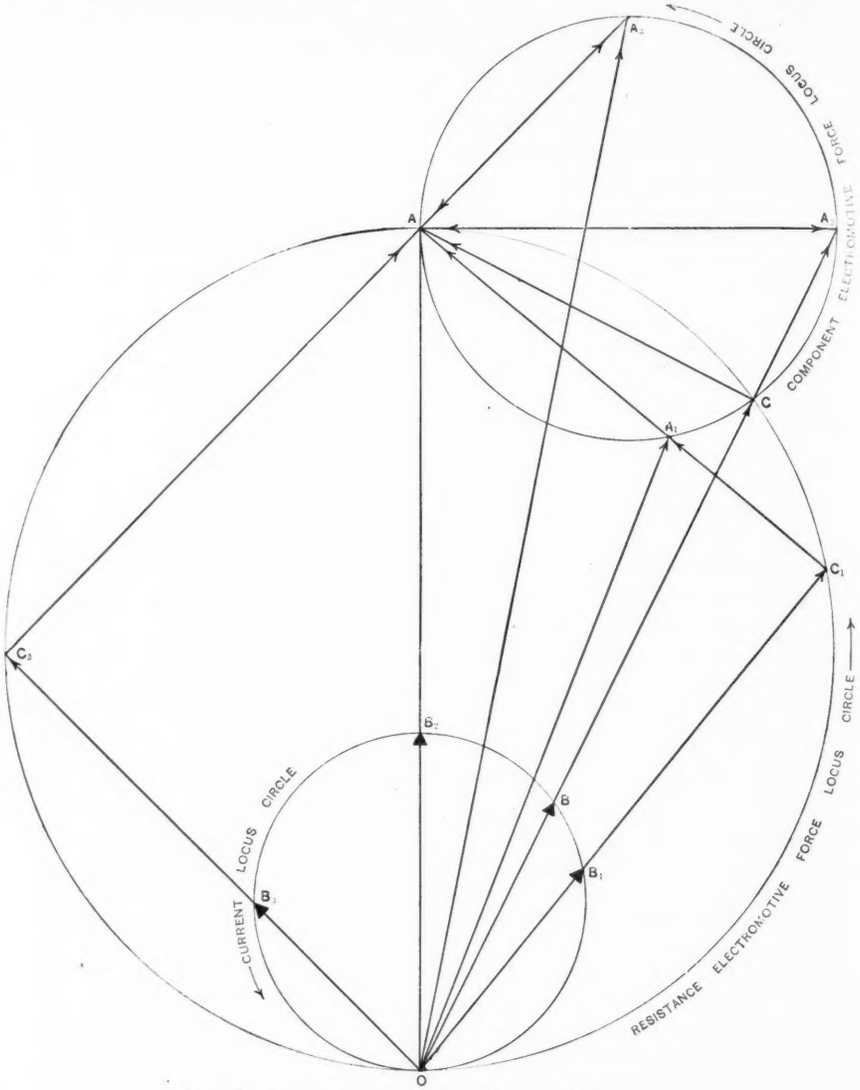


FIG. 67.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

Telegraph Wires on Snow—The fact that snow is a good insulator has been practically recognized by the employés of the Puy de Dôme Observatory for a number of years, says the *Electrician.* The double line which connects the observatory with the station of Rabanesse and with the telegraph office of Clermont is often interrupted during the Winter season. The breakage is due to the fact that the poles, covered with a layer of hoar frost, which can attain a diameter of three feet, offer too large a surface to the winds, which blow with great violence. It often happened that in the execution of repairs the workmen drew a line of wire across the snow covering the Temple of Mercury, so that the wire was in contact with the snow over a length of 30 or 40 yards. Even when the poles remained standing it often happened that their tops were covered with snow, and that quite 1,000 yards of wire were in immediate contact with it, without the messages be-

ing disturbed on that account. It might be urged that the best expedient would be to lay the wire always on the snow, as in the case of the Etna and Mont Blanc observatories. But on the Puy de Dôme the snow is not "eternal," and it is often either melted or blown away, leaving the bare rock.

Unipolar Induction—Most physical cabinets contain an apparatus to illustrate the rotation of a magnet about a current which is conveyed axially through the

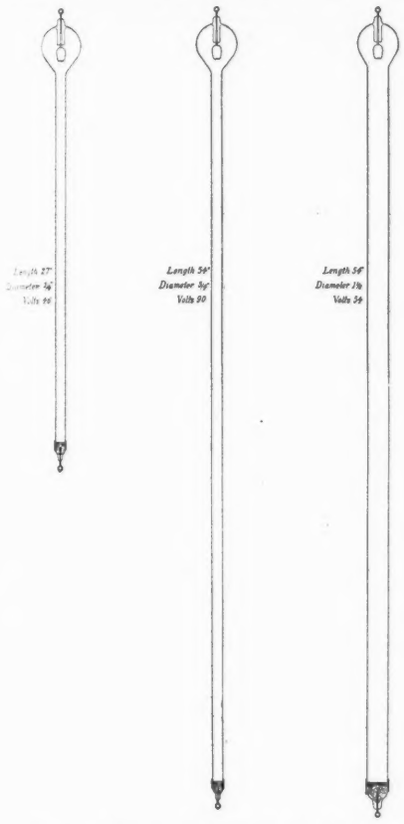


FIG. 1.—COOPER HEWITT VAPOR LAMPS.

magnet. This rotation is generally attributed to unipolar induction. A discussion of the reality of the existence of this inductive action has continued through the past few years. Lecher has maintained that the effect is due to the leading-in wires. Herr E. Hagenbach, in a leading article of the *Annalen der Physik,* maintains that the rotation of the magnet is a true phenomenon and falls under Biot and Savart's law, which states that an infinitely long straight current acts upon a magnetic pole with a force which is proportional to the current strength and to the strength of the pole and is inversely proportional to the distance. Laplace proved that a stream element acts upon a magnetic pole with a force which is inversely proportional to the square of the distance, and Biot showed that it is proportional to the sine of the angle which the direction of the current makes with the line connecting both elements. The author enters into a discussion of Ampère's laws, Grassman's law and the Biot-Savart law in relation to this experiment.

OBITUARY.

Mr. Richard P. Rothwell, editor of the *Engineering and Mining Journal,* died at his home in New York, on April 17, after an illness of several weeks. Mr. Rothwell was born in Canada in 1837, and was educated at Trinity College, Toronto; the Rensselear Polytechnic Institute, at Troy, N. Y.; the Imperial School of Mines, in Paris, and the Mining Academy, at Freiberg, Saxony. Returning to America in 1864 he engaged in engineering in the Pennsylvania coal fields for several years, meanwhile devising wire-rope-making machinery and other machines and processes, many of which are still in use. In 1873 he became editor of the *Engineering and Mining Journal,* and has lately published also the *Mineral Industry* and other works and periodicals. Mr. Rothwell founded the American Institute of Mining Engineers in 1871, and became its president in 1882. He was a member of a large number of scientific and engineering societies in various parts of the world.

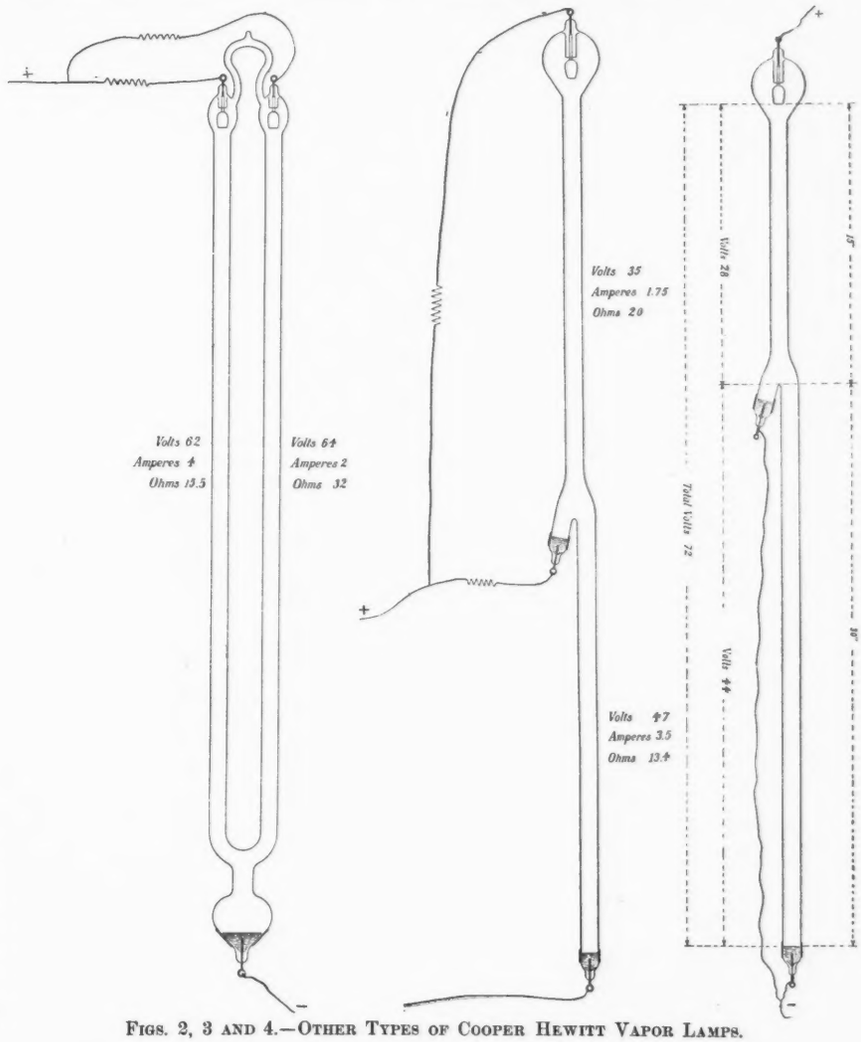
Mr. Henry Herbert Luscomb, secretary and superintendent of the Johns-Pratt Company, Hartford, Ct., died in that city on April 17.

NOTES ON THE COOPER HEWITT LAMP.

BY PETER COOPER HEWITT.

The purpose of the exhibit which I had the honor to present at Columbia University, before the American Institute of Electrical Engineers on April 12, 1901, was:

First: To demonstrate that light can be produced from a gas or vapor in great quantity by means of the electric current, and in the quantity desired.



FIGS. 2, 3 AND 4.—OTHER TYPES OF COOPER HEWITT VAPOR LAMPS.

Second: To demonstrate that light can be produced from direct-current low-voltage circuits, by means of a gas or vapor.

Third: To show that this light is extremely efficient.

Fourth: To illustrate laws of conduction of the electric current by gases or vapors, and to show by experiment the effect of current on a conducting vapor or gas and the effect of variation in density of the conducting vapor on the current passed.

Fifth: To exhibit the electrical phe-

nomena at the joint of the negative electrode with a gas or vapor.

Sixth: To exhibit practical electric vapor or gas lamps of very high efficiency.

Seventh: To demonstrate that change in the color of the rays of light proceeding from a gas or vapor lamp of this

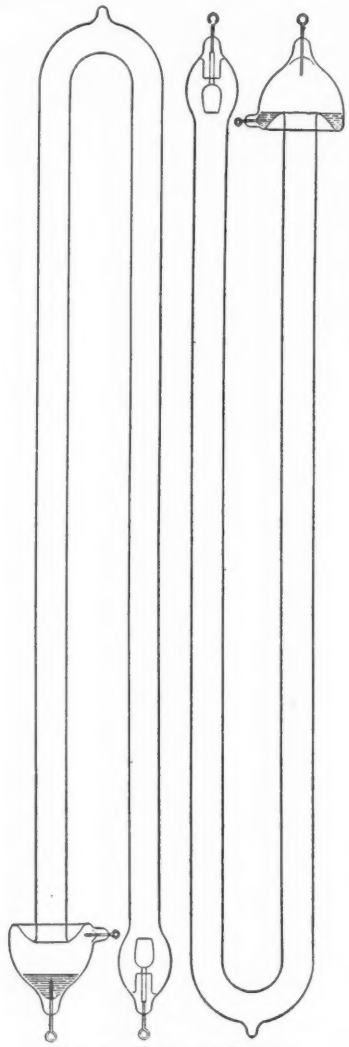


FIG. 5.—VERTICAL LAMPS.

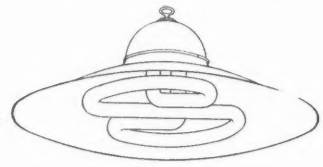
character can be brought about by means of certain materials.

Eighth: To show, by means of curves, that the resistance of a particular vapor in a lamp can be made to vary in a predetermined manner within wide limits by varying the proportion of the vapor subjected to the current and the heat radiating ability of the lamp.

The demonstrations actually made are illustrated by the accompanying drawings, and the measurements on the drawings were taken by Weston instruments while the lamps were in operation.

Fig. 1 illustrates the relation of the volts to the dimensions of a gas carrying current. The demonstration consisted in the operation of three lamps illustrating the tendency of the volts to vary directly as the length and inversely as the diameter, as seen by the figures of the drawing. One lamp is 54 inches long and three-quarters of an inch inside diameter, another is half the length and the same diameter, and the third is the same length as the first and twice the diameter; the drop in volts of the second and third is approximately one-half that of the first. The error in the lamp having the greater diameter, which measured 54 volts instead of 45, as should have been the case, was probably due to impurity developing in the vapor and a factor which appears on comparing tubes of widely different diameters.

Figs. 2 and 3 of the drawings illustrate the relation of current to resistance; the resistance varying inversely with the



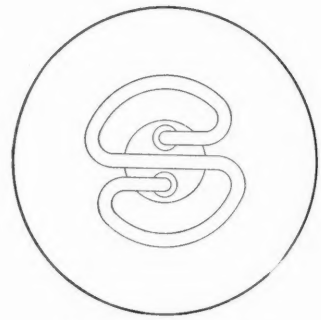


FIG. 6.—SPIRAL LAMP.

current, the volts tending to remain constant. Fig. 2 illustrates a divided vapor circuit, one leg carrying four amperes, while the other leg is carrying two amperes, the voltage over each leg being approximately the same.

The second demonstration, Fig. 3, illustrates a divided circuit consisting of a lamp with an additional electrode midway between the other two, whereby the current in the upper portion of the lamp is one-half that in the lower portion. The drop in volts over each of these portions should have been the same and the resistance of one should have been half that of the other, but for the discrepancy which was due to the greater vapor density in the lower portion owing to the presence of the mercury forming the negative electrode.

The next demonstration, Fig. 4, was a lamp having an auxiliary electrode one-third of the distance between the positive and the negative electrode, which on be-

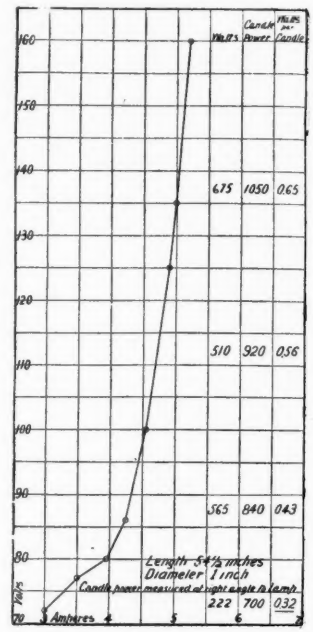


FIG. 7.

ing connected with the negative electrode, by a conductor having a negligible resistance, allowed only 0.02 of an ampere to pass through this short-circuit, although it was subjected to a measured electrical pressure of 44 volts, while the lamp was passing about three amperes.

These demonstrations practically illustrated results obtained by me from a great number of experiments.

Figs. 5 and 6 illustrate two forms of my lamp adapted to run on an Edison 110-

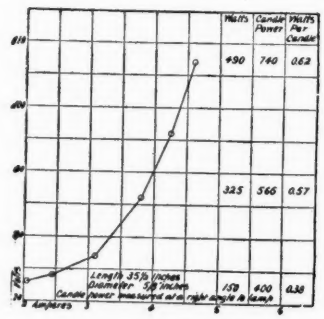


FIG. 8.

volt circuit with an efficiency of one-half a watt per candle.

Figs. 7, 8 and 10 show actual efficiencies of my lamp at different electric pressures, while Figs. 7 and 8 and 9 illustrate the control of the resistance of the lamp.

Fig. 10 illustrates the electrical variation due to variation in gas density and

an immediate effect of variation in current and a result brought about by a variation in gas density.

Fig. 11 illustrates the effect on one of my lamps of varying its heat-radiating ability.

Fig. 12 is the efficiency curve for the same lamp.

The large lamp exhibited was operated

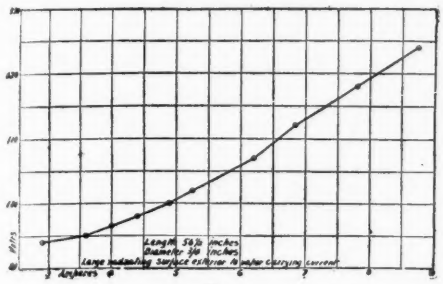


FIG. 9.

by direct current. The Weston ammeter in circuit with the lamp indicated seven amperes. The drop in volts across the lamp was 100 volts, measured by a Weston voltmeter, and the light given by this lamp was approximately 1,500 candles. It was, I believe, the first public exhibition of a high-power vapor lamp, and it was exhibited with standard instruments attached for measuring its current consumption; in fact, all the demonstrations were made with standard instruments attached for general inspection.

Heavy Storm in the West.

An unusually severe storm damaged property to the extent of nearly $3,000,000 in western Pennsylvania, Kentucky, West Virginia, Tennessee and throughout the southwestern central states on Saturday and Sunday last. From Pittsburgh south, towns along the Ohio, Monongahela, Scioto, Kanawha and Big Sandy rivers suffered greatly from the floods, while to the north telegraphic communication between Chicago and New York was possible on Saturday only by way of Montreal or Ottawa, Canada. Telegraph, telephone and railway companies are heavy losers, the wires being down or wrecked throughout a large portion of the states named.

Experts of the General Electric Company tested searchlights on Niagara Falls from Falls View recently. The Michigan Central Railroad Company has long desired to give its patrons a view of the falls under the electric light operated by the power of the falls itself.

PERSONAL.

Mrs. Isabel Field Judson has recently given to the National Museum a half American, half British flag which was flown by her father, Mr. Cyrus W. Field, on the U. S. frigate Niagara, in 1856 and 1857, when that ship was engaged in laying the first Atlantic cable. The flag, which is 45 feet long, is triangularly divided representing the ensigns of both

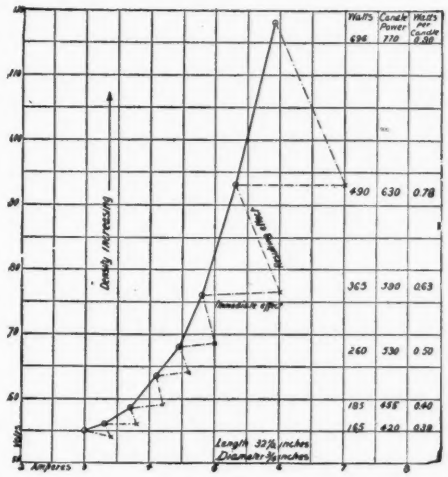


FIG. 10.

countries, and is intended to complete the already fine Field collection which is now in the museum. The flag was made under Mr. Field's immediate direction and in addition to being used on the Niagara at the laying of the first cable it was also carried on the Great Eastern in 1866 and 1867, when the second cable was laid.

Mr. Alexander Brown, of Baltimore, Md., has resigned from the various corporations with which he is connected preparatory to taking a long trip abroad

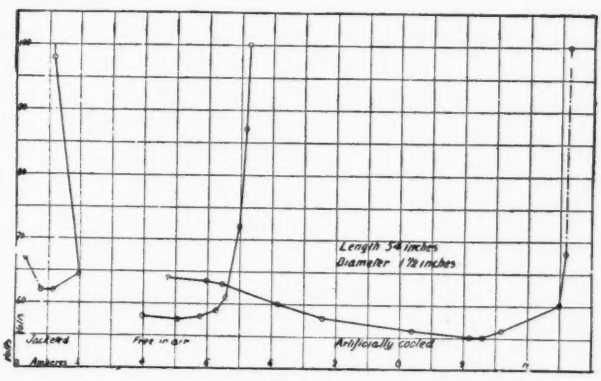


FIG. 11.

for recreation. Among the companies in which Mr. Brown was interested are the United Railways and Electric Company, United Electric Light and Power Company, Canton Company, Newport News & Old Point Comfort Railway and Electric Company. As Mr. Brown's health has been impaired by his close attention to business, his physicians have advised him to rest, and he sailed for Europe on April 24 with his family.

Messrs. R. Mountford Deeley and J. W. Woolliscroft, directors of the Midland Railway Company, and Arthur Keen, chairman of the Dowlais Iron, Steel and Coal Company, Limited, and E. Winsor Richards, a director in the same company, arrived from London on the Majestic re-

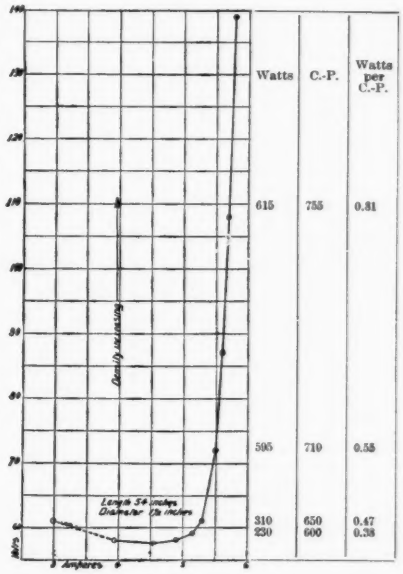


FIG. 12.

cently, and paid a visit to some of the gentlemen connected with the Morgan-Carnegie steel interests with a view to studying American methods as exemplified in the plans of the great steel combination.

Mr. A. A. Thresher, of the Thresher Electric Company, Dayton, Ohio, was a New York visitor last week. Mr. Thresher states that his new company, with greatly increased facilities, is well under way and he will probably arrange for branch offices in eastern cities. The Thresher apparatus is largely used in the navy yards and is giving the best of satisfaction under very severe usage.

Mr. C. E. Trump, of the Novelty Electric Company, Philadelphia, Pa., was a New York visitor the first part of this week. Mr. Trump reports an outlook for a very busy Summer in the electrical field and remarked that last year July and August were two of the busiest months and that it seemed likely this would be repeated in 1901.

Mr. W. C. Humstone, superintendent of the Western Union Telegraph Company, of New York city, has recently returned from Florida, where he has been with his wife for the benefit of her health.

A Telephone Newspaper.

In Budapest, which is one of the most advanced capitals of Europe, there is in operation an institution known as the *Telefon-Hirmondo,* which, being interpreted, means "telephonic news teller." It is fully described by Mr. Thomas S. Denison in the *World's Work* for April. To the courtesy of this publication we are indebted for the accompanying illustrations.

In short, the system consists of a fully equipped newspaper office—equipped, that is, in every respect except presses, type, paper, and printer's ink. It has 6,200 subscribers, and a full staff such as would be usual in a newspaper of fair size in such a city. The enterprise was started about eight years ago by Mr. Theodore Buschgasch, and after his death continued by Mr. Emile von Szveties.

For the purposes of telephonic dissemination of news the city is divided into 27 districts. To a distributing point in each is run a copper wire main circuit with branch wires to the houses of subscribers. Similarly 27 circuits are run from transmitters in the Opera House to the central office. In all, the newspaper service operates 560 kilometres (372 miles) of wire and 6,200 receivers in the various houses. The actual "issue of the paper" is carried out as follows: In each subscriber's premises is attached to the wall a complete programme telling just what may be expected at any hour each day, except Sundays and holidays, between 10.30 A. M. and 10.30 P. M., unless a concert or some other night event is being reported. Stock exchange reports reach subscribers several hours ahead of the evening papers. Reports of the legislative body and political news occupy the time from 11.45 to 12 o'clock. General news, of course, comes in all day at intervals. At 1.30 and 6 P. M. a brief résumé is sent out for the benefit of those who missed the first news. From five to six P. M. there are concerts, varied with literary criticism, sporting events, and so on. Special items for Sunday include news from 11 to 11.30, a concert from 4.30 to 6 P. M., while a children's concert is given every Thursday evening at six o'clock.

The *Telefon-Hirmondo* is independent in a sense not known in America; it has no leading articles, no editorials, no opinions—unless its short notices of literature and art can come under the last head. The editor alone is responsible in case of action against the paper for libel. He has already had two or three lawsuits, but has won all of them.

The mechanical processes of the paper are about as follows: The news (telegraphic, exchange, specials, and locals) is secured by the ordinary methods known in all newspaper offices. The reporter who has finished his assignment writes out his matter in ink and submits it to his chief, who signs it on the margin of the printed form. The signature fixes responsibility. A clerk then takes the copy and carefully copies it with lithographic ink on long galley slips. These are transferred to the stone so as to appear in parallel columns about six inches wide and two feet long. Two pressmen take several impressions on a roller-movement hand press. Common printing-paper is used. Each sheet is submitted to an assistant editor, who, with the aid of a copyholder, exactly as in proof reading, verifies its correctness. This sheet constitutes the file, and a duplicate is cut up into convenient strips for the use of the stentors. Each sheet comprises a certain part of the programme, and the whole number of sheets, with hour dates, constitute the day's file.

The stentors are six in number in Winter, when the paper is likely to be crowded with important matter, four for duty and two alternates. In Summer four suffice. The stentors have strong, clear voices and distinct articulation, and the news comes from the receivers with remarkable strength and clearness. When all six stentors are present, they take turns of 10 minutes each; if for any reason only two are on duty, a half hour is the extreme required of one reader.

The only ladies employed on the staff are those who sing in the concerts.

It is stated that the current expenses range up to about $4,200 a year, including interest on the plant, while the fixed charges are about $2,850 a month, varying in different seasons. The subscription price is 18 florins, or $7.56 a year. Of course advertising receipts are strictly limited, though advertisements are included in the service, the charge being 42 cents for each 12 seconds.

REPORTERS ON THE TELEPHONE NEWSPAPER OF BUDAPEST.

The subscribers to the service include most of the prominent people in Budapest, appealing as it does to the more intellectual classes of that exceedingly wideawake and busy city.

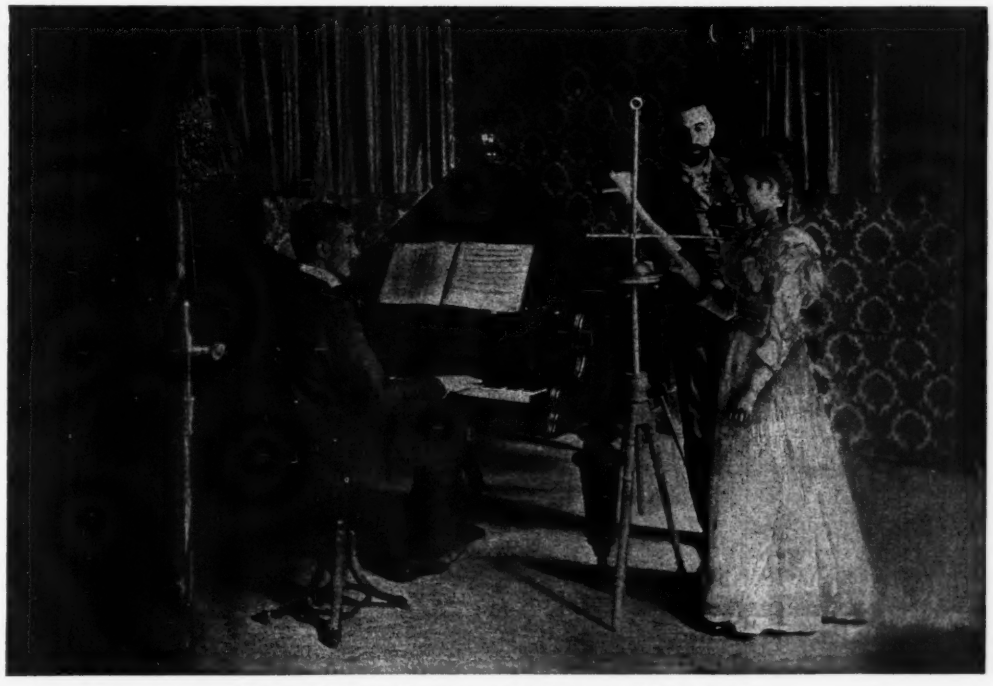
The "aggrieved subscriber" sometimes wishes to stop his paper, but he can not do this as easily as a subscriber to a printed journal. In the first place, he has had a receiver put into his house at the company's expense and he has been obliged to give security for a year's subscription, one-third of which he pays when the instrument is ready for use. He pays the balance in two equal payments, at the end of four months and eight, respectively.

If the grievance is real, the editor tries to remove it by means of the soft answer that turns away wrath from the editorial head; if imaginary or absurd, the paper keeps the time-honored waste basket for its reception. The editors and managers receive the usual courtesies extended to the press in the way of passes and free tickets, and the paper exchanges with the city press. Unknown persons, such as temporary lodgers or boarders in hotels, can not, of course, become subscribers, but the principal hotels do subscribe, and their guests are free to use the instrument.

A Stentor Reading the Day's News to 6,200 Subscribers.

Hirmondo is at present trying an experiment with "penny-in-the-slot" machines. The coin used is a 20-*filler* piece, worth about two cents in our money. Music by telephone, whether vocal or instrumental, still leaves something to be desired. The telephone timbre must be got rid of before music can be transmitted satisfactorily. The report of news, however, is highly satisfactory.

So far as a stranger can judge, who is wholly ignorant of the language of the country, says Mr. Denison, the enterprise is distinctly a success. The paper is so well known and has accomplished so much that it appears to be beyond the stage of experiment so far as Budapest is concerned. One strong point in its favor is its early reports. In this respect the paper has a strong hold, for it is able to issue an "extra" at any hour of the day. Moreover, invalids and busy people may get as much news as they want with little effort. Indeed, the plan has so many advantages, that we shall probably soon see it in operation on this side of the ocean, with the improvements that Yankee ingenuity will be sure to devise.



In the Concert Room of the Telephone Newspaper.

Reports from Pittsburg, Tex., state that the plant of the Pittsburg Ice and Electric Light Company was destroyed by fire.

German Industries at a Standstill.

A writer in the *Berliner Tageblatt* recently takes an exceedingly gloomy view of the industrial conditions in Germany to-day and says that they are so bad that charitable efforts are powerless to cope with the situation, as reduced production and the continual dismissal of working people have become so general as no longer to attract attention. The writer goes on to state that out of the entire working population of the German Empire nearly a quarter are idle or insufficiently employed, and he believes that there is little prospect of any immediate improvement in the situation as the matter was made more serious than was expected by the uncertainty of Germany's commercial policy, which has succeeded in driving German capital and intelligence to found large industrial undertakings abroad while hindering business relations with foreign countries. In Silesia prices are so depressed that even the ironworks, which possess their own coal mines and furnaces, are reported to be unable to cover operating expenses. Plants for the manufacture of tinplate, tubing and electrical supplies are in a similar plight, while textile industries are nearly paralyzed. Many of the factories are said to have been closed and in others the hours of labor have been reduced to a minimum, while outside the gates large crowds are looking for employment every day. The pressure of these conditions is felt even by the wealthy classes in almost the same proportion as the working and professional classes, but it is stated to be less general.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—IX.

BY A. E. DOBBS.

HOUSE TERMINALS.

In Fig. 35 is shown a cable terminal enclosed in a sheet-iron cover which possesses the advantage of being easy to open—though it can be locked if need be—

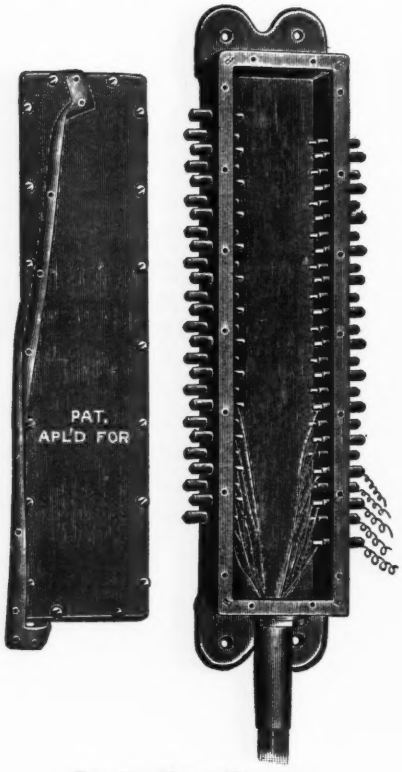


FIG. 35.—HOUSE TERMINAL.

and of occupying little space, which, in certain places, is very desirable.

It, however, possesses one disadvantage: In a storm—it often happens that terminals have to be visited in a storm—it allows rain or snow to blow directly on the cable head, which should be avoided as much as possible.

Neither should a cable head be left exposed to the weather without any protection, and for this purpose nothing is better than a box made in the shape of a house, well painted inside and out to prevent the absorption of moisture, as well as warping and cracking. In this the head can be placed and it can be opened up without wetting the terminal posts on a wet day.

UNDERGROUND CABLES.

So far, underground construction has not been taken up because it does not interest small exchanges to any great extent. Yet as some comparatively small towns require this class of work it will be well worth while to give it a passing notice in order that owners may act intelligently if such requirements are made. Let us suppose that we have a town where there are plenty of alleys and where, as a consequence, digging and paving are not expensive, it would seem that it would be as cheap to lay an underground as to string an overhead system, and so it would except for the matter of distribution. Except in large blocks poles would have to be set anyhow, in order to distribute the wires which therefore would also require several feet of extra cable to reach their distributing boxes. Cable for underground work must be nearly twice as heavy as that intended for aerial lines, which makes it more costly with no corresponding advantage in life or efficiency. As pointed out in a previous chapter, the difference in the weight of a 100-pair cable would be, say, 3,000 pounds for an aerial and 5,000 pounds for an underground cable 1,000 feet in length. On the other hand, even a heavy line of poles can scarcely carry, or rather sustain, more

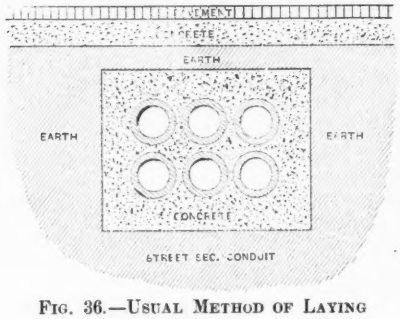


FIG. 36.—USUAL METHOD OF LAYING TILE DUCTS.

than 10 cables without breaking down, so that the limit is soon reached in that direction.

An underground conduit can not very well be kept dry, so that cables are therefore continually exposed to dampness.

The simplest and easiest system to install is probably an iron-pipe conduit, but it has the disadvantage of comparatively short life and increasing the inductive and electrolytic troubles of the cable, and in cities where there are gas pipes the liability to explosion from imperfect grounding of the cable at certain spots. Another cheap system is the pump-log or wooden conduit, well creosoted, and which has, in consequence, a very long life; but there is a strong suspicion among cable men that the creosote may sooner or later attack the cable and destroy it, though this is stoutly denied by the wooden-conduit men. In Brooklyn, N. Y., conduits have been laid now for about 15 years and the writer has never heard of any trouble from this source.

In the laying of conduits care should be taken to get them level so that there may be no hollow places for water to stand in and, if possible, it would be better for them to have a considerable slope so that if water does get in it will have a chance to run out toward one end or the other. It is almost impossible to make a conduit water-tight and in order that water may run out of the manholes a drain is sometimes placed in the bottom connecting with the sewer. Manholes should not be located farther than 500 feet apart, as a longer pull than 500 feet of cable is apt to be an expensive proceeding.

There are other kinds of conduits now on the market, consisting of vitrified clay, these having the advantage of lasting almost indefinitely, which are used more than any other kind at the present time. Some kinds are glazed on the inside, which makes them a very good insulator for the cable sheath and distributes the small amount of leakage uniformly, so that the danger from electrolysis is greatly reduced or entirely obliterated—a point not to be overlooked, which also applies in a somewhat lesser degree to wooden and cement conduits. There is also the cement arch which also has the merit of cheapness and is probably as good as any. Since all tile conduits, at least, have to be laid in cement anyhow, why not do away with the tile and use cement altogether, built up on a form strong enough to hold it in place?

Some of the early experimenters along this line conceived the idea of using a three-inch tin or sheet-iron pipe which

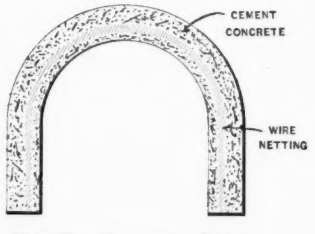


FIG. 37.—CONCRETE ARCH.

would merely hold the cement in place till it could set. This was all very well in theory, but it was found that laborers were not always as careful as they should be and that when they came to pull the cable into the conduit that some of these thin pipes had been walked on and bent and crushed so that they had to be dug out again before they could be used.

Another ingenious gentleman once conceived and took out a patent on a tube made of soft-rubber hose which was placed in the conduit and filled around with cement till it set, when by pulling and

stretching the soft-rubber tube it would come out, leaving a hole in the cement. But even if frail tubes of tin and paper could preserve their forms they would decay in course of time and obstruct the duct if the cable should be withdrawn.

Fig. 36 shows the usual method of

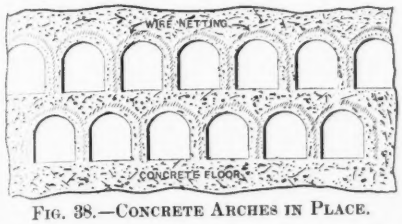


FIG. 38.—CONCRETE ARCHES IN PLACE.

laying tile stone or cement ducts. First the trench is dug to the proper depth and a layer of cement and broken stone two inches in depth is laid. Then the tile stone tube or cement arch is laid in place and a single row again covered with cement until another level floor is made, when another row of tubes is laid and the whole covered with cement.

In making joints it is usually the practice to cover them with tarred burlap to keep out the dirt and, as far as possible, moisture.

Fig. 37 shows details of what is known as the cement arch, which is simply a form made of concrete over a wire netting bedded in the centre to hold it in place. In laying, a cement floor is leveled off and the arches placed on that floor. All joints are wrapped with burlap and cement filled over the first layer to a depth of two inches, when another row of arches can be laid till the full number is in place. In conduit work it is generally considered that a square or half-round duct is easier to pull a cable through, for the reason that in the latter case only a small part of the cable's diameter is in contact with the floor of the pipe. One conduit company

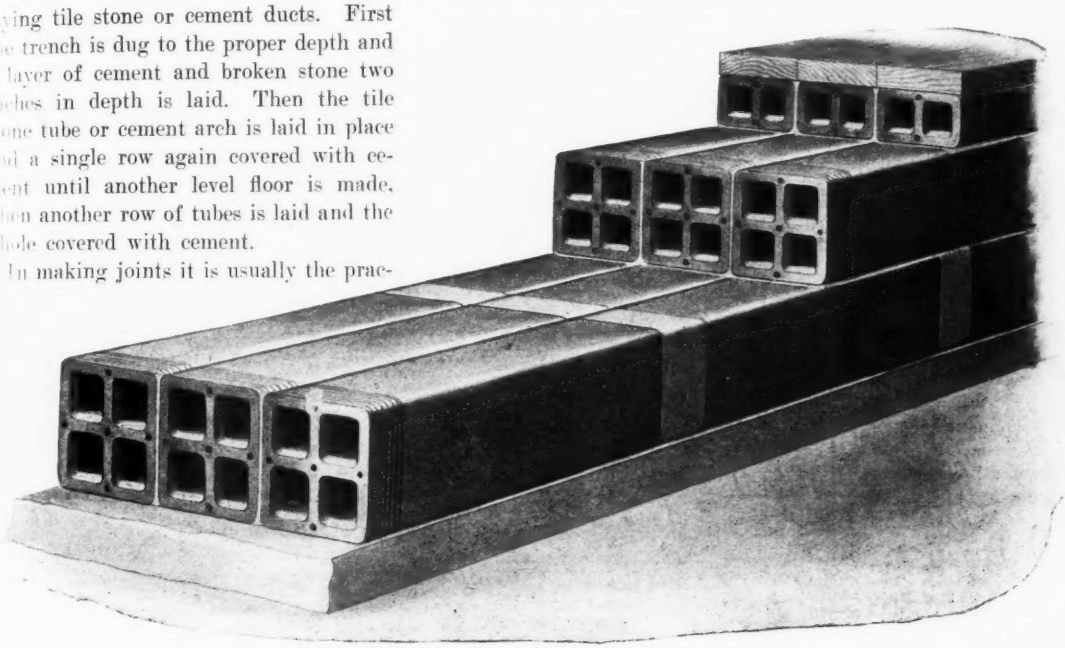


FIG. 39.—MULTIPLE DUCT CONDUITS WITH CONCRETE BASE AND BOARD COVER.

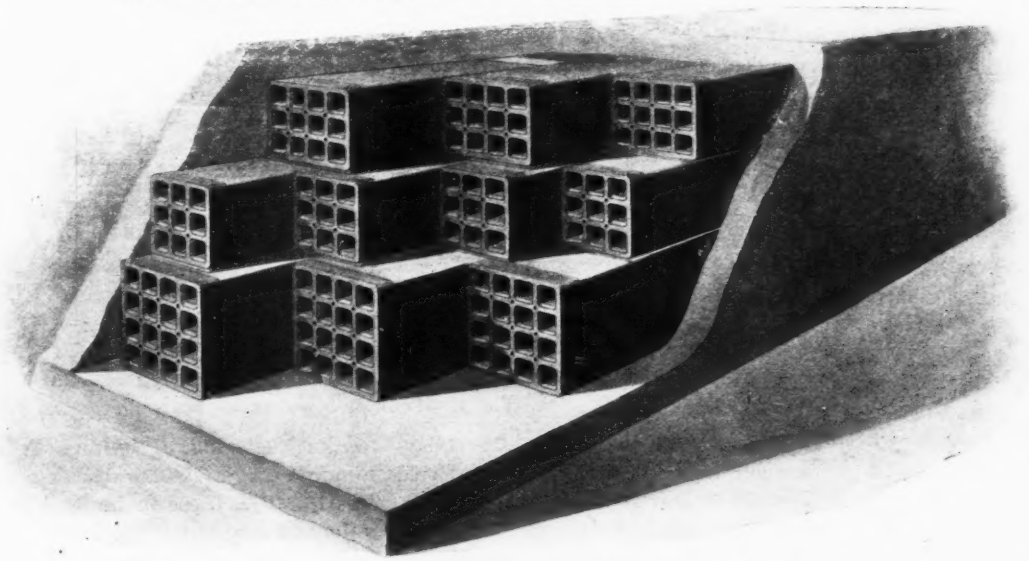


FIG. 40.—MULTIPLE DUCT CONDUITS WITH COMPLETE CONCRETE ENVELOPE.

(the American Vitrified Conduit Company) gives out the following specifications which illustrate the different classes of work:

MEMORANDUM FOR SPECIFICATIONS ON CONDUIT LAYING.

CLASS A—After the trench has been excavated and the bottom carefully leveled, a bed of concrete shall be laid on same and well rammed, with a width equal to the width of the conduits to be laid on same, and of an average thickness of three inches. After the conduits have been laid in position and joints made, a two-inch covering board or plank shall be laid on top for the width of the conduits. Plank may be hemlock, spruce, pine or cypress, of a fair quality and reasonably straight. The earth to be then filled in on sides and top and well rammed or puddled.

CLASS B—After the trench has been excavated and the bottom carefully leveled, a bed of concrete shall be laid on same, and well rammed, with a width equal to the width of the conduits to be laid on same and of an average thickness of three inches. After the conduits have been laid in position and joints made, a two-inch layer of concrete shall be placed on top of conduits for their width. The earth shall be filled in on sides and top and well rammed or puddled.

CLASS C—After the trench has been excavated and the bottom carefully leveled, side boards of one-inch spruce, pine or hemlock, of fair quality, with strips nailed on back of same, shall be placed in position at the two sides of trench at a distance apart of six inches more than the width of conduits, and seven inches higher than the height of conduits to be laid in same. Nailing pieces, one by two inches, shall be secured to the two sides about every eight feet on top and bottom across the trench where required to hold the side boards in place.

A bed of concrete averaging four inches thick shall be then placed in bottom of trench for the width between the side boards. On this the conduits shall be laid and joints made, and conduits carefully centered to give a width of three inches on sides between conduits and side boards. The sides and top shall then be filled up with concrete to make

a complete concrete envelope around conduits, with a thickness of four inches in bottom and three inches on sides and top.

CLASS D—Same as Class C, with the addition of one-inch boards in bottom of trench to lay concrete on, to be used where necessary to secure bottom for concrete, as at New Orleans.

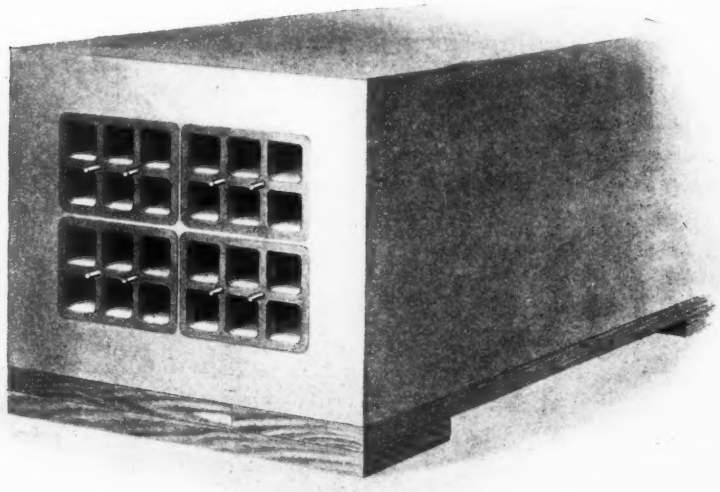


FIG. 41.—MULTIPLE DUCT CONDUITS WITH CONCRETE ENVELOPE ON PLANK BASE.

CONCRETE—The concrete shall be cement concrete made as follows: One part natural cement (Hoffman, N. Y. Bridge Brand, Improved Union or equal thereto), two and one-half parts of clean, sharp sand, and five parts screened gravel, crushed stone, ashes or furnace slag, and to be small enough to pass through one and one-half-inch mesh.

CEMENT MORTAR—Cement Mortar shall be composed of one part natural cement (Hoffman, N. Y. Bridge Brand, Improved Union or equal thereto), two and one-half parts of clean, sharp sand.

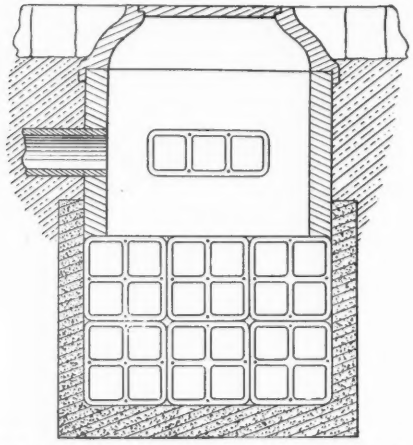


FIG. 42.—MANHOLE WITH IRON BOX AND COVER.

An ordinance has recently been passed in Denver, Colo., which prohibits the operation of an automobile at any greater speed than six miles per hour. The Denver authorities have not only made the law, but have employed mounted policemen to enforce it.

Views, News and Interviews

A leading ear specialist of New York recently visited the laboratory of Mr. Edison at Orange, N. J., and in conversation with him asked how long he had been partially deaf.

"Since I was a boy," replied Mr. Edison.

The specialist said he would like very much to make an examination, which he did later with the result that he announced his belief that Mr. Edison could be made to hear as well as any one. Mr. Edison repeated this to one of his associates a day or two later.

"Of course you will have the operation performed?" was the response.

"What! And give up the great advantage I have over the rest of you fellows!" was the quick reply. "Why I need it in my business, for you see my business is thinking, and no matter what the rest of you are doing, or how much noise you are making, it doesn't bother me and I am able to concentrate my mind fully upon the subject in hand without interruption. Give up an advantage like that! Not much, until, possibly I get so old I can not work any longer."

Mr. Edison from this point of view evidently is willing to sacrifice his personal convenience for the advantage of his life's work; yet if the science and skill of the specialist can improve his hearing his multitude of friends would undoubtedly be delighted to see him thus benefited. The incident emphasizes the strong need by the thinking part of the human race for *earlids* as well as eyelids.

The exclusive announcement in the ELECTRICAL REVIEW last week of the election of Mr. Frederick P. Fish as director and president of the American Telephone and Telegraph Company has been received with much favor by the Bell telephone interests of the country. Mr. Fish has been very active in electrical litigation for a number of years, having been counsel for the Thomson-Houston Company and afterwards general counsel for the General Electric Company. For the last five or six years he has been general counsel of the American Bell Telephone Company, succeeding the late J. J. Storrow. It is understood that Mr. Fish leaves a practice of nearly $100,000 per annum, and that his salary as president of the telephone company will be that figure. He is a young man, about 42 years of age, and has been engaged in the practice of law since his graduation from Harvard in the class of 1875.

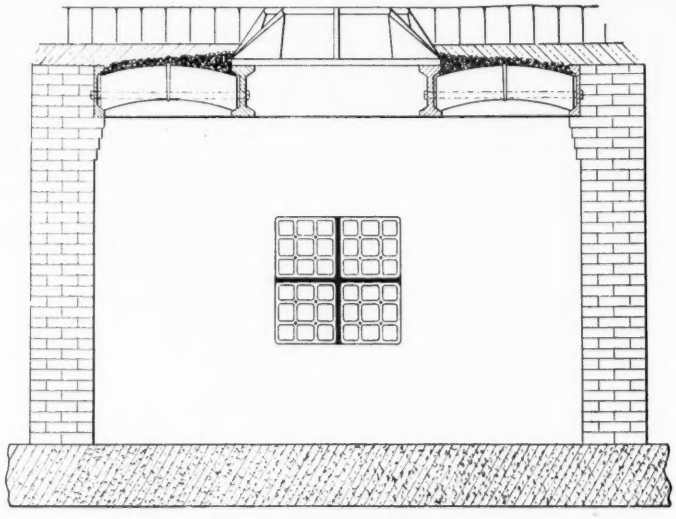


FIG. 43.—FORM OF MANHOLE.

THE DISTRIBUTION AND CONVERSION OF RECEIVED CURRENTS—I.*

BY HENRY GORDON STOTT.

Before proceeding to the subject proper of this paper it will be interesting to give a brief description of the apparatus and lines generating, transforming and conveying the current from Niagara Falls to the terminal house at the city limits of Buffalo, where the overhead lines terminate and the underground distributing system for the various purposes to be hereafter described begins.

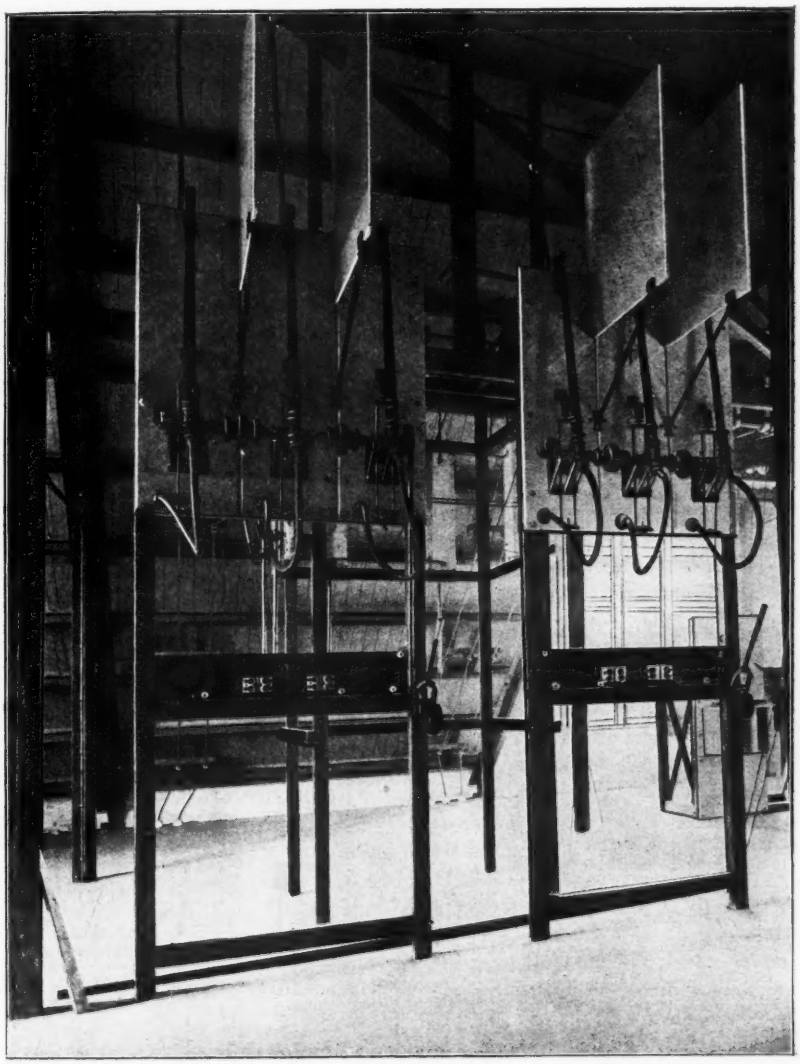


FIG. 1.—HIGH-TENSION CIRCUIT-BREAKERS.

The power received in Buffalo originates at the well-known plant of the Niagara Falls Power Company, at Niagara Falls, N. Y., in water-driven turbines direct-connected to 5,000-horse-power two-phase 2,200-volt 25-cycle generators. Ten of these generators are now installed, and a new wheel pit is being excavated on the south side of the surface canal, parallel to the present power-house, for 12 more generators of the same size, which will give an ultimate total capacity of 110,000 horse-power, and it is a very safe prophecy to say that every horse-power of it will be sold as fast as the turbines and generators can be installed, as the present installation of 50,000 horse-power is all contracted for, and already many customers find themselves in the position of Oliver Twist, and with no better results.

The 2,200-volt two-phase current is conducted into the transformer house, where, after passing through time element overload circuit-breakers, it enters two distinct banks of step-up transformers of the air-cooled type, of an aggregate capacity of 12,000 kilowatts, which are arranged in pairs for the two-phase-three-phase connection, at the same time to change the pressure to 11,000 volts. Within a couple of months the secondaries, which are now in multiple, will be connected in series to give 22,000 volts as originally intended.

The 11,000-volt three-phase current from the secondaries of the two banks of transformers is brought directly out in cables on large special porcelain insulators set in iron fixtures in the air chamber, and then on the regular helmet type porcelain insulators on timbers on the wall. The lightning arresters are of the usual multi-gap type with reactive coils in series, and in a second type with an additional check to the current in the shape of carbon resistances to prevent the live current following the lightning discharge.

The two three-phase 11,000-volt circuits running on the same poles to Buffalo, each consist of three bare stranded copper cables of 350,000 circular mils area, forming equilateral triangles on each side of the pole, the sides of the triangles being three feet. In the run of 23 miles to Buffalo, the lines are transposed five times in order to equalize and minimize the inductive drop on all phases, and at Tonawanda, where a branch line is taken off for Tonawanda and Lockport, lightning arresters are installed of a type similar to those used at Niagara Falls and Buffalo. During the first two years operation of this line, iron guard wires grounded at every alternate pole were used for protection from lightning, but so much trouble was caused by them falling on the lines that after striking a balance between the supposed protector and the known trouble, the result was so overwhelmingly against the former that the guard wires were taken down, and the interruptions, due to line trouble, very materially reduced. The remaining trouble on this part of the system was almost exclusively due to the ever present boy, who speedily discovered that by a little dexterity in the manipulation of an old piece of iron wire or hoop, he could produce brilliant Fourth-of-July effects at will. The cables were, at this time, only 18 inches apart, and an arc once established would travel backwards along the line with ease until the circuit-breakers eventually opened at the Falls. This trouble was remedied very effectually by separating the cables three feet apart as at present, and at the same time arranging them so that they formed a triangle with the apex below instead of all being on the same plane as formerly.

At the terminal house, situated at the city limits of Buffalo, the lines now terminate in a common set of bus-bars, and to these bus-bars are connected the five

* A paper read before the American Institute of Electrical Engineers, March 22, 1901.

three-conductor lead-covered cables which lead to the various substations.

Simultaneously with the increase of line pressure to 22,000 volts there will be installed in the terminal house six 2,250-kilowatt step-down transformers of the oil and water-cooled type, reducing the pressure to 11,000 volts for distribution in the underground cables.

A third line is now being built from Niagara Falls to the terminal house, following a different route, in order to give greater security of service, but as the present pole line is built with very heavy poles 90 feet apart, no great anxiety is felt as to the possibilities of even Lake Erie zephyrs combined with sleet affecting it.

Following the current as it comes into the terminal house on the 22,000-volt lines, we first come to the lightning arresters which are of the well-known multi-gap type, the connections to each line having a reactive coil inserted to prevent the rush of static discharge being followed by a greater current, from the line, than the gaps of non-arcing metal can interrupt by cooling off the air and extinguishing the arc at the zero period of the wave. As an interesting fact it may be observed that the number of one-thirty-second inch standard gaps necessary to prevent the current arcing across under normal conditions is not directly proportional to the pressure, but increases in the same ratio as the arcing distance in air of a single gap.

The high-tension circuit-breakers shown in Fig. 1 are of a very simple form, but one which has invariably given excellent results, being simply a long hollow wooden arm containing a flexible insulated conductor, which completes the circuit through copper contact blocks, with auxiliary carbon contacts for breaking the arc. When the circuit-breakers open, the arm describes the arc of a circle giving a break of over three feet, and as the arc ascends rapidly, due to the currents of hot air generated by it, the length of the arc is rapidly increased until broken. The position of the marble barriers above the panel illustrates the height to which the arc may be expected to rise in extreme cases. After passing through the circuit-breakers the current is led to bus-bars, and from these to the two groups of transformers, only three cables being carried from the panels to each group of three transformers, as the delta connection is made at the terminals. The low-tension or 11,000-volt secondaries are connected in the same way to the bus-bars on the secondary panels, and from here the five three-conductor lead-covered cables distributing the current to the various substations in Buffalo, receive their current after passing through the usual recording and indicating meters and circuit-breakers of the same type as on the 22,000-volt side. All these circuit-breakers have a time element device which can be regulated so as to make the circuit-breakers open only after a short-circuit has lasted a predetermined number of seconds; similar devices are used on all overload circuit-breakers, the time limit varying inversely as the distance from the source of power, in order to prevent the more distant stations shutting down the others.

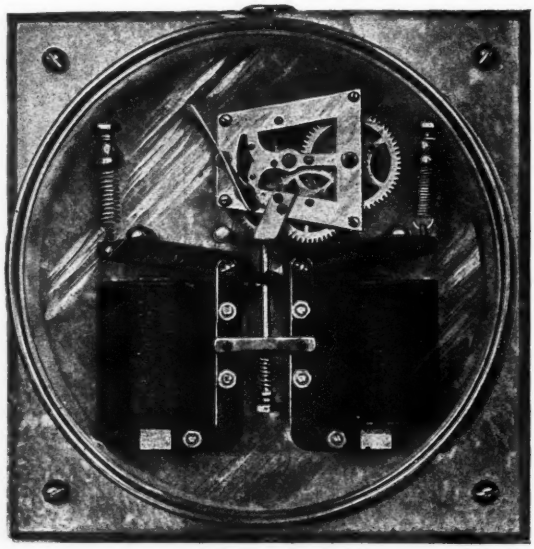


FIG. 2.—A VIEW OF ONE OF THE TIME-ELEMENT RELAYS.

The two coils are connected respectively with current transformers in two phases of the line. Either releases the clockwork which after a proper interval closes a local circuit through the tripping coils of the breakers

We now come to the distribution and conversion of the current in Buffalo, but the scope of this paper will only permit of the more important and novel features being taken up and described in the briefest manner possible.

DISTRIBUTION.

Referring to the diagram, Fig. 5, showing the system of distribution connecting the seven substations to the terminal house, it will be seen that there are five three-conductor cables leaving the terminal house, each substation being connected to at least two cables, either one of which is capable of carrying the full load, and in the other stations having more cables, any two are capable of carrying the full load. The necessity for duplicate service to prevent shut-downs through cable trouble is so obvious as to necessitate no further comment, but the automatic apparatus used to cut out the faulty cable is novel and interesting. Before describing the system a brief description of the various circuit-breaking apparatus used will be in order.

Fig. 1 shows a type of breaker used in the terminal house and in substation No. 3, which has already been described; Figs. 2 and 2A show one known as the shunted fuse type, in which the current is carried by a spring copper leaf brush which is forced into contact with the copper blocks by means of a toggle joint lever. In shunt with this is a copper fuse wire 20 inches long of No. 22 B. & S. gauge fastened in a groove in a stick having near each end brass contacts, which, when the fuse stick is forced into the receptacle mounted in the marble panel, forms a shunt on the circuit-breaker proper. The fuse stick is covered with fibre paper, and three holes are punctured through this paper, so that when the stick is in place in the enclosing wooden tube, the holes in the paper exposing the copper wire are opposite three fibre chimneys. The gases

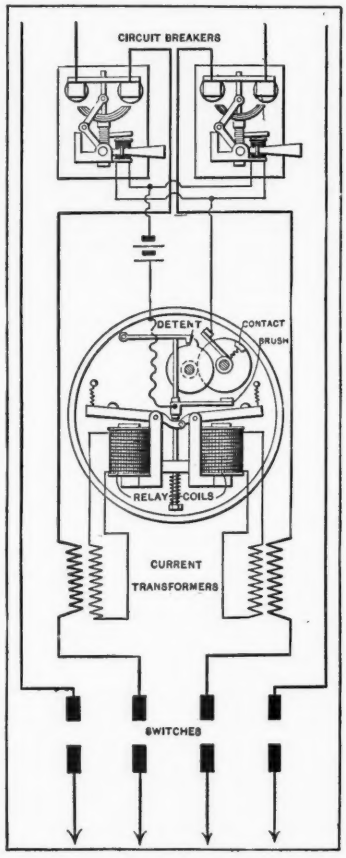


FIG. 2A.—DIAGRAM OF CIRCUIT-BREAKER CONNECTIONS.

formed by the melted copper escape with such force through these chimneys, shown in Fig. 2B, that the arc formed after the circuit-breaker trips, is blown out with a noise resembling the report of a pistol.

To reset the circuit-breaker, the switches in series with it are opened, the old fuse stick replaced by a new one, the circuit-breaker closed, and last of all the switches. This form of circuit-breaker has given excellent results on both 2,200 volts and 11,000 volts. A time element relay is shown in Fig. 2, which is used on the overload apparatus, the retardation being accomplished by a train of clockwork operated by an ordinary spring. The brake on the clock train (which is normally at rest) is released by either of the two magnets, one being connected to the secondary of a transformer in series with phase No. 1, and the other similarly connected to phase No. 2, the diagram showing the connections for a two-phase circuit. Variation of the time limit is accomplished by changing the angle of the air paddles on an axis normal to the spindle driving them.

Fig. 3 shows a third type of switch which may be operated by air, controlled by a relay or by any other agency, and consists simply of a U-shaped copper rod connecting two brass cylinders, with spring sockets, filled with oil. When the U-shaped rods are withdrawn from the copper receptacles at the bottom of the cylinders the arc is broken in oil in two places. The cut illustrates the separation of the phases by means of brick partitions, so that in case of failure a short-circuit can not take place. These switches have also given excellent results on all pressures.

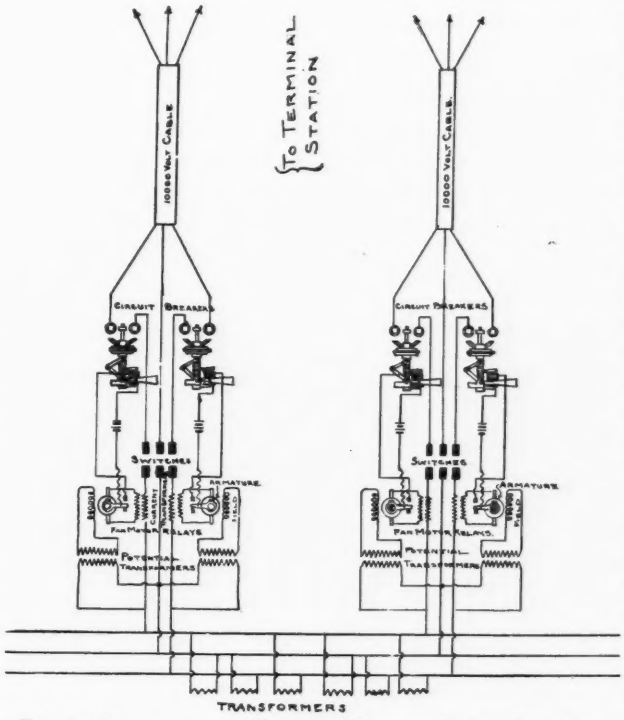


Fig. 4.—Connections of Reversed Current Circuit-Breaker.

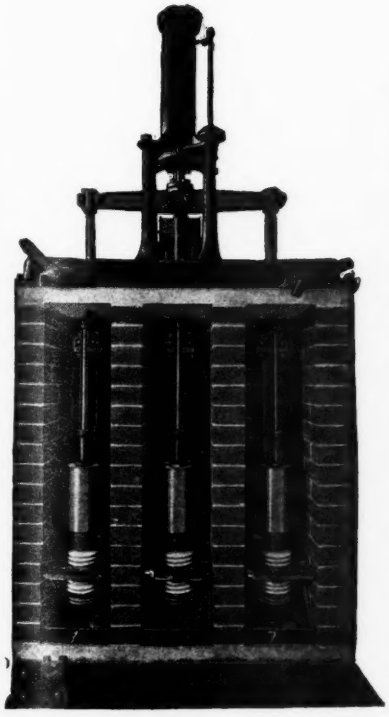


Fig. 3.—Air Operated Switch.

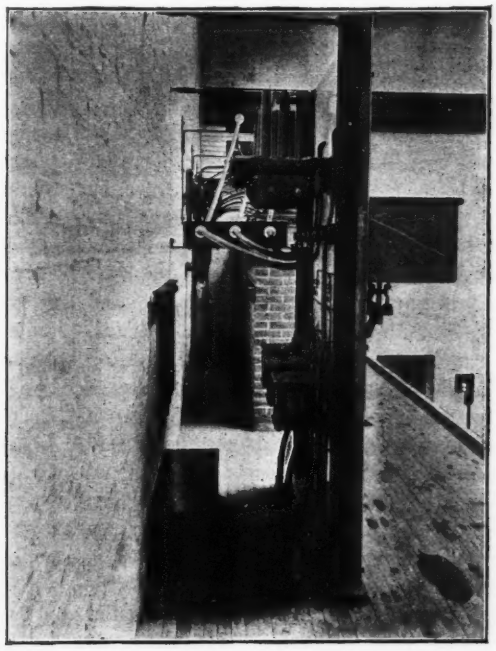


Fig. 2B.—Mounting of Circuit-Breakers.

It is quite obvious that any substation supplied from two cables in multiple through overload circuit-breakers, is thoroughly protected from damage due to failure of apparatus in itself, but a few moments' consideration will also show that it is not protected from a shut-down due to one of the cables supplying it becoming defective, and thereby causing the second cable's circuit-breakers to trip, from current supplied through them to the short-circuit in the cable. To obviate this the reversed current circuit-breaker has been devised, and the connections are shown in Fig. 4. The circuit-breaker proper is of the same type as those shown in Figs. 1, 2 and 3, but the novelty lies in the means of tripping it. The relay consists of a small direct-current fan motor having laminated fields and armature, the armature circuit receiving current from the secondary of a transformer connected in series with one of the phases of one cable, the fields receiving current from a small constant-potential transformer connected to the same phase. The armature shaft carries an arm whose play is limited between two stops, one of which is connected to the tripping coil of the circuit-breaker, the other stop being blank. Normally with these connections the torque exerted upon the armature is in such a direction that the contact arm attached to the armature shaft is strongly pulled against the blank stop, a spring assisting in this pull.

Suppose that a short-circuit comes on No. 1 cable, the conditions are now radically changed; the normal flow of current into the bus-bars from both cables no longer exists, for No. 2 cable will now be feeding current into the short-circuit in No. 1 cable through the bus-bars and circuit-breakers of No. 1, thereby reversing the direction of the flow of energy in the armature circuit of its relay, and as the field remains the same as before, the contact arm swings over rapidly, completing the local circuit and tripping the circuit-breakers, leaving the substation bus-bars connected to the good cable only. The same action will take place at all the substations to which this cable may be connected, and finally the overload circuit-breakers in the terminal house will cut out the faulty cable entirely.

ACCUMULATORS AND AUTOMOBILES.

BY LOUIS BELL.

The notes on storage batteries for electric vehicles, published in your issue for April 13, must have wakened a sympathetic chord in every engineer who has tackled the problem. Mr. Fay hit the nail squarely upon the head. Personally, I have never been celebrated for my optimistic view of the storage battery, but the evolution of the past decade has not been without purpose or altogether profitless, and at the present time, and for the purpose under discussion, the storage battery is quite as much sinned against as sinning. The public electric vehicle business here in Boston is reported to have come to grief, but it certainly does not appear that intrinsic faults in the batteries or lack of skill in the engineers of the hapless company are properly chargeable with the unhappy result.

When the gearing of an electric cab can be distinctly heard for a quarter of a mile, buzzing and whirring like a Cyclopean mosquito, it is not an unreasonable hypothesis to assume that there is energy lost elsewhere than in the battery. The mechanism of an electric vehicle requires careful design and construction in order that it may do its work smoothly and steadily without unreasonable wear and tear, and in the early stages of the manufacture of such vehicles it is not at all remarkable that there have been many sins against good construction.

It is far too early in the game to form a correct judgment of the relative merits of the various motive powers proposed and used for motor vehicles, but it is quite safe to say, in spite of frequent failures and numerous discouragements, that the electric carriage is with us to stay, and that the storage battery, if given a fair chance, will do its work well. The writer has had occasion recently to overhaul the possibilities of the case, and the result has convinced him that with careful attention to general design and to the running gear in particular, trouble with the batteries will be greatly diminished.

Storage batteries are not intrinsically light, but there are more ways of killing a cat than choking the beast with cream, and every watt that can be saved in the gross power required for operation means a reduction in weight, cost and bulk of the battery required. If care in the design and construction of the running gear and the motors can reduce the power required to drive the vehicle by 15 or 20 per cent, which, as regards ordinary present practice, seems well within the bounds of possibility, the net result will be to lessen the weight of the battery by perhaps a couple of hundredweight, while retaining the same radius of action.

If preferred, the gain can be taken in the form of extra capacity or increased efficiency of the batteries, but in any case the gain has been made and to good purpose. Overcrowding the battery is another greviously common failing in motor carriage design. A long chapter could be written on the disadvantages of compactness in electrical apparatus, as well as in mechanism generally. It sometimes is a necessary evil, and sometimes can be gained without material inconvenience, but while compactness gained at the expense of accessibility is bad, compactness gained by sacrificing efficiency is worse. A storage battery that has to be greatly cramped for room loses in both these particulars. It is hard to get at quickly for repairs, is prone to all forms of leakage, and is pretty certain to be skinned as to active material, or electrolyte, or both. In either case it suffers in efficiency and durability without adequate compensation in reduced weight.

A few added inches in height, length and breadth of the battery space mean better insulation, stronger and more reliable connections, lessened danger of short-circuiting the plates and better circulation of the electrolyte. And there is generally no good reason why a proper amount of space should not be given. There is little to lose and much to gain by giving it.

American motor carriage builders have been very slow to depart from the usual models of vehicles intended to be drawn by horses, and by this conservatism have seriously handicapped the designer of the driving mechanism. There is no good reason why in an automobile the form and size of the body should not be fully adapted to the new conditions instead of being slavishly correlated to the presence of a spectral horse. Foreign makers have been more progressive in this particular and while at first glance some of the types which they have evolved look rather queer, it is because of their newness and not from any real lack of shapeliness or suitability.

Electric carriages have a considerable advantage over other forms of automobiles in that the total amount of mechanism and the driving apparatus proper is sufficiently compact, but there must be adequate free space for storing the battery, and room stolen from it will inevitably be paid for at high rates in the repair bills. Steam and gasoline vehicles too frequently suffer from over-compactness and one of the secrets of the success of the French in developing such machines is that they appear to have started with the intention of making the apparatus work properly, even if it looked like a machine shop on wheels, while in the effort to produce a neat and tasteful carriage more than one American maker has so cramped his machinery that you could hardly drop a nickel into the body without stopping the wheels, while outside there is hardly room to carry a toothbrush unless you stick it in your hatband. Small wonder that repairs are formidable.

It may be that the next few years will produce a storage battery much lighter and more durable than anything which is now familiar, but even with the best batteries now available the situation can be very greatly improved by attention to the motors and to the general design. The electric carriage has certain advantages in quietness and simplicity of operation that will give it a field of its own wherever charging current becomes available. Neither it nor any other automobile will endure persistent abuse, but the much maligned battery will stand its share if it is only given a fair chance.

Annual Meeting of the Independent Telephone Association.

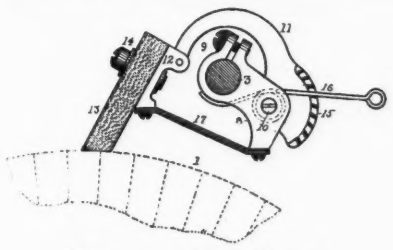
The fifth annual convention of the Independent Telephone Association of the United States of America will be held at the Pan-American Exposition grounds, Buffalo, June 11, 12 and 13. The complete programme of the meeting will be announced later. It should be understood that the Pan-American Exposition has made arrangements with all railroads to carry visitors at one and one-third fare round trip.

The committee on arrangements is composed of Sam. E. Wayland, Scranton, Pa.; Robert R. Hefford and Clark L. Ingham, of Buffalo, and these gentlemen will arrange for special rates at the hotels for persons attending the telephone convention.

The officers of this association are: James M. Thomas, president, Cleveland, Ohio; H. C. Young, first vice-president, Columbia, Pa.; C. E. Stinson, second vice-president, Rochester, N. Y.; H. E. Teachout, third vice-president, Des Moines, Iowa; S. P. Sheerin, secretary and treasurer, Indianapolis, Ind.; R. F. Johnson, first assistant secretary, Saginaw, Mich.; Samuel E. Wayland, second assistant secretary, Wilkesbarre, Pa. In addition there is an advisory board composed of Hugh Dougherty, Bluffton, Ind.; E. B. Fisher, Grand Rapids, Mich.; W. H. Durin, Cedar Rapids, Iowa; W. B. Seaton, Ashland, Ky.; George W. Beers, New York city; H. D. Critchfield, Mt. Vernon, Ohio.

Recent Electrical Patents

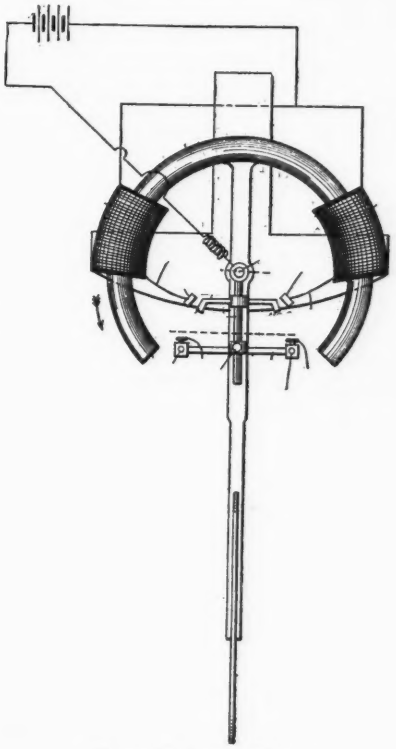
Another commutator brush-holder has been designed and patented by William D. Pomeroy, of Akron, Ohio, who has assigned his entire interest to the Akron Electrical Manufacturing Company. The aim of the invention is to provide means



COMMUTATOR BRUSH-HOLDER.

whereby the brush may be readily adjusted, and will automatically take up the wear to which it is subjected so that a good electrical contact will always be maintained with the commutator. Broadly, the construction consists of a body secured upon the wrist-pin and carrying a pivotally-mounted bracket, which is provided at one end with the usual commutator brush, and at the other with a plurality of notches. A coiled spring surrounds the pivot of the bracket, and has one end bearing under the body portion of the holder. The other end projects outwardly and is arranged to engage in the notches of the bracket. It will thus be seen that by placing this projecting end of the spring in different notches the brush carried by the opposite end of the bracket will be urged more or less into yielding engagement with the commutator, so that as the brush wears it will still maintain such contact.

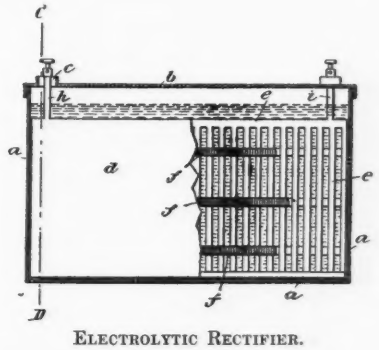
A rather novel idea in electrical fans is an oscillating fan that has just been patented by Mr. Richard W. Schmelz, of Brooklyn, N. Y. In the practice of the invention, an inverted T-shaped support is provided, to the extremities of the horizontal arms of which are attached two solenoids. Pivoted between these solenoids is a vertical arm, to the lower end of which is attached a fan blade, while the upper end carries a circular magnet, the ends of which are passed respectively through each solenoid. Secured to this arm, contiguous to the pivot pin, is a pair of outwardly projecting fingers that are arranged successively to make contact with binding-posts fastened to the frame when the arm is oscillated. Each of these binding-posts is connected to one terminal of one of the solenoids, while the other terminals of the solenoids are connected to a battery. This battery also has a connection with the fingers. The operation will be readily understood. When an electric current is passed through one of the solenoids it will draw in the magnet and thus move the arm until the finger makes contact with the binding-post. The circuit will thus be completed which will move the arm in the opposite direction, and thus the fan is continuously



NOVEL ELECTRIC FAN.

oscillated. To stop the motion it is only necessary to stop the fan in a vertical position, whereupon both circuits will be open; and to start it again, it is only necessary to move the arm until one of the fingers is in contact with the binding-post.

Novel means for converting alternating currents have been patented by M. Albert Nodon, who resides in Paris, and has protected himself in this country by a patent. The improved arrangement consists, essentially, of an electrolyte formed of a solution of phosphoric acid to which may or may not be added ammonia and in which are plunged two electrodes, the one of graphite or plumbago and the other of an alloy of zinc and aluminum. This electrolyte, interpolated in an alternating circuit, has the property of arresting one of the elements of the alternating current while allowing the other to pass freely. The phosphoric acid is the active substance of the electrolyte and forms insoluble salts with the zinc and aluminum of the alloy electrode. The addition of ammonia is useful owing to the protective action of this compound, which is passive —that is, it forms no soluble salts with the zinc and aluminum, but it preserves the alloy electrode from a too strong attack by the phosphoric acid and insures a regular working of the apparatus. In order to effect the continuous converting of these two alternate phases, it suffices to arrange in parallel two similar couples having their electrodes disposed in a reversed order. In this manner it is impossible to collect two direct and distinct currents corresponding, respectively, to each of the phases of the alternating current. It has been found by experiments that two similar couples organized in this manner permit of converting alternating currents having a mean electro-motive force up to 200 volts. By observing the phenomenon it will be seen, on the one hand, that the operation of the apparatus is accompanied with a deposition of hydrogen upon the metallic electrode and, on the other hand, that each of the converted cur-



ELECTROLYTIC RECTIFIER.

rents possesses individually an electro-motive force equal to half of the total electromotive force of the primary alternating current. The current thus converted may be utilized either separately— for example, for feeding arc lamps and for charging accumulators—or simultaneously for operating electromotors. In the latter case the electromotor employed must be provided with a double winding of the field magnets, the armature, and the two collectors, and its magnetic mass must also be divided, so as to avoid self-induction.

A good-sized electric lighting and power plant is to be erected in the near future at Smithville, Ky., by the Louisville, Mt. Washington & Fairfield Railway Company to light both the company's yards and offices and the town. Judge W. B. Hoke, of Louisville, is president of the railway company.

Electric Lighting

The Montgomery, W. Va., Light, Water and Improvement Company has recently been chartered in that city, with a capital stock of $50,000, by J. C. and J. W. Montgomery.

An electric lighting plant is to be erected in Winchester, Tenn., as soon as bids have been received and accepted, the plant to operate 20 arc and 500 incandescent lights, the upset price being stated as $26,000.

Extensive purchases have recently been made by the Knoxville, Tenn., Electric Light and Power Company for the purpose of enlarging its plant. The added equipment gives the plant 3,050 extra horse-power.

A dam and electric lighting plant which will cost about $20,000 are soon to be built on the Shenandoah River at Grottoes, Va., from which place power will be transmitted to the city of Harrisburg, Va., by underground cables.

Reports from Albany, N. Y., state that the Hammond bill, which sought to permit unrestricted competition for electric lighting contracts in second-class cities in the State of New York, was killed in the Senate on April 18 by a vote of 22 to 21.

Newspaper despatches from Spanish Fork, Utah, state that that city and the neighboring town of Springville are considering the question of erecting an electric lighting plant to be used jointly by both towns. The cost is estimated at about $30,000.

A company will be organized in the near future in Greenville, Miss., with a capital stock of $25,000, by Henry Crittenton and others, to erect and maintain an electric lighting plant which may possibly be sold to the city after it has become well established.

At the recent election in Butler, Ohio, the people of that town voted a $10,000 bond issue for the erection of a municipal electric lighting plant and bids are already asked for a plant to operate 25 1,500-candle-power arcs and 800 16-candle-power incandescent lamps.

An electric lighting plant is soon to be erected in Ft. Gaines, Ga., by the Ft. Gaines Mill and Power Company to operate about 500 lights. Mr. J. H. Fulford, who is connected with the power company, is said to be also interested in the electric lighting enterprise.

Reports from Phœnix, Ariz., state that the Phœnix Light and Fuel Company will develop power on the Arizona Canal, about 20 miles east of that city. Particulars of the proposed installation may be had from D. W. Belden, superintendent for the company.

A boiler explosion in the plant of the Paxton, Ill., Electric Company resulted in entirely demolishing the east end of the plant, and crippling the lighting service of the town. The damage is estimated at about $15,000, which is nearly covered by insurance.

It is announced that the date for opening the bids for a 15-year franchise from January 1, 1902, for a plant and electric lighting contract for the city of Suffolk, Va., has been postponed until May 14. Further information may be obtained from Mr. W. M. McAnge, the chairman of the electric lighting committee for the town.

The annual meeting of the stockholders of the Rochester, N. Y., Gas and Electric Company resulted in the election of the following directors for the ensuing year: J. Lee Judson, William Runkle, Frederick Cook, George W. Archer, Albert H. Harris, Granger A. Hollister, Walter S. Johnston, George C. Hollister, Harry L. Brewster, John N. Beckley, George A. Redman, Wray L. Cole, Charles B. Judson. These officers were elected for the coming year: President, J. Lee Judson; first vice-president, Frederick Cook; second vice-president, William Runkle; treasurer, George W. Archer; secretary and assistant treasurer, Wray L. Cole; attorney, Albert H. Harris.

The recently noted combination of electric lighting interests in Montreal, Canada, was perfected by a young French-Canadian, M. Rudolph Forget, who was two years ago the president of the Royal Electric Company in that city. The new company will be known as the Montreal Light, Heat and Power Company and proposes to take in all the gas and electric lighting companies in the city and vicinity. At the present time all, with the exception of the Lachine Rapids Hydraulic and Power Company, have consented to be merged in the new concern, and it is considered only a question of a short time when the last-named corporation will consent to come in. When all the financial arrangements have been completed the new company will have $25,000,000 of capital, of which $17,000,000 will be underwritten at once. Associated with M. Forget in the enterprise are James Ross, the millionaire street railway man; R. B. Angus, Charles R. Hosmer and others.

Telephone and Telegraph

The Trempeleau & Buffalo County Telephone Company was recently organized in Independence, Wis., with the following officers: President, C. H. Cook; secretary, E. Jackson; treasurer, O. Pederson; manager, A. J. Bautch. The system will run from Independence to Gilmanton and Thiesen post office, and is expected to be in operation by June 1.

Reports from Wadena, Minn., state that the Northern Minnesota Telephone Company a short time ago sold its system to the Central Minnesota of Wilmar for $25,000. The sale includes all the company's exchanges from Sauk Centre to Akely, and its franchises in the cities of Staples, Melrose and Monticello, in which places exchanges will be immediately installed.

Mr. Charles E. Wisard, the gentleman who installed a telephone line at Alexandria, S. D., is soon to install a similar system in Woonsocket, and expects to have his system working very soon. The name of the company is said to be the Woonsocket Telephone Company, and it is reported to have a capital stock of $2,500. Messrs. E. M. Smith, C. V. Templeton and others, are the incorporators.

Recent incorporations in the state of Ohio include the Tri-County Telephone Company, which was chartered by A. K. McConnell, H. W. Townsend and others; the Citizens' Telephone Company, of West Unity (local service), for $15,000; the Ohio Construction and Finance Company, of Cleveland; the Swanton Telephone Company, which was organized for $10,000 by F. J. Spencer, P. J. Lenhart and others; the Ashley Telephone Company (local service) for $6,000, and the Winona Central Telephone Company, organized by Joseph Masten, M. L. Baker and others, for $10,000.

Sharp competition and a keen rate war are going on in Carroll, Md., between the Western Maryland and the Chesapeake & Potomac telephone companies, the latter being subsidiary to the Bell system. The lines of the Western Maryland company give service within the county only, and are used principally for toll service, while the Chesapeake & Potomac lines reach all the towns along the Western Maryland Railroad and connect with the lines of the Bell long-distance system, extending all over the country. Rates have been cut and it is said that considerable feeling is manifested, but this report could not be confirmed.

Electrolysis in the Bleaching of Textile Fabrics.

The subject of the application of electrolytic bleaching methods in textile manufacture is the theme of an interesting report from Mr. Ernest L. Harris, United States Consular Agent at Eibenstock, Germany, from which the following description is taken:

FIG. 1.—ORDINARY ELECTRIC BLEACHING APPARATUS.

Dr. Oettel, a German professor, together with Haas & Stahl, electricians in Aue, Saxony, has invented an apparatus for producing "chemic," or bleaching liquor, out of ordinary brine, the product being sodium hypochlorite, which is attracting considerable attention among textile manufacturers. It is claimed that the chemic obtained by this method produces a whiteness superior to that of the English bleaching liquor.

The ordinary apparatus is extremely simple (see Fig. 1), being mainly a trough or box of slate, swung on trunnions, in a suitable frame, with an inlet for the brine and an outlet for the sodium hypochlorite resulting from the passage of a current of electricity through the brine as it runs through the box, the poles or electrodes being placed at opposite ends of the box, as shown by the engraving.

Thermometers are suspended at the inlet and at the outlet, in order to show at a glance the strength of the sodium hypochlorite, it having been found that every rise of five degrees Celsius corresponds to one gramme of free or active chlorine per litre (equal to 62 grains per gallon).

In order to clean the apparatus, the thermometers are removed and the trough reversed and cleansed with a hose pipe. The electrodes last about one year and can be easily replaced. The bleaching liquor, the product of the apparatus, is eminently suitable for bleaching raw cotton, yarn, cloth, lace, and the finest embroidered fabrics, made of cotton, linen, jute or flax, pulp, paper, etc. It advantageously replaces chloride of lime for all purposes.

The advantages claimed for this system are:

1. The electrolyzed solution possesses the highest decolorizing or bleaching power.

2. The goods treated in the ordinary process of bleaching are not harmed in the least, and there is scarcely any appreciable loss in weight.

3. Lime or magnesia salts are not deposited on the cloth, thereby eliminating any possible trouble in subsequent dyeing and printing.

4. Constant strength of liquor, which can be used as fast as made, if desired.

5. Economy in cost of production.

The apparatus is constructed in three sizes, to produce, per 10 hours, respectively, 350, 650, and 1,000 gallons of electrolyzed solution, containing three grammes per litre (equal to 186 grains per gallon) of active chlorine, prepared from brine of a strength of six degrees Baumé.

For purposes of comparison, we may say that 650 gallons of the electrolyzed solution contains 20 pounds of active chlorine; to obtain from chloride of lime 20 pounds of active chlorine, it would be necessary to use 70 pounds of bleaching powder, and the resulting 650 gallons would be found to give considerably inferior results. The reason of this apparently inexplicable difference lies in the constitution of the electrolyzed liquor, which has been found to contain the following: Free chlorine, free hydrochlorous acid, sodium hypochlorite, and chlorate of soda. It is chiefly the free hypochlorous acid which causes the rapid bleach. This solution is absolutely harmless to the fibres of the threads, the best proof that they are in no way injured being that goods bleached by electrolysis only lose about two per cent, as against some eight per cent for chloride-of-lime bleach.

When making further comparisons between the new and the old methods, it is well to bear in mind the well-known fact that chloride of lime quickly loses its strength. It is invariably assumed to be of some given standard; but, as the hydrometer test is deceptive and other tests are troublesome, guessing is generally resorted to, and cloth is often spoiled. In this apparatus, the difference between the readings of the two thermometers is a ready and infallible test, though that is scarcely needed after once regulating the flow of the brine and the electrical current. The electrolyzed liquor is always of one strength; mixing or reducing is not necessary, neither does the apparatus need any attention. Rock salt or sea salt may be used in addition to waste salt for mixing brine, providing it contains no mineral injurious to the subsequent processes.

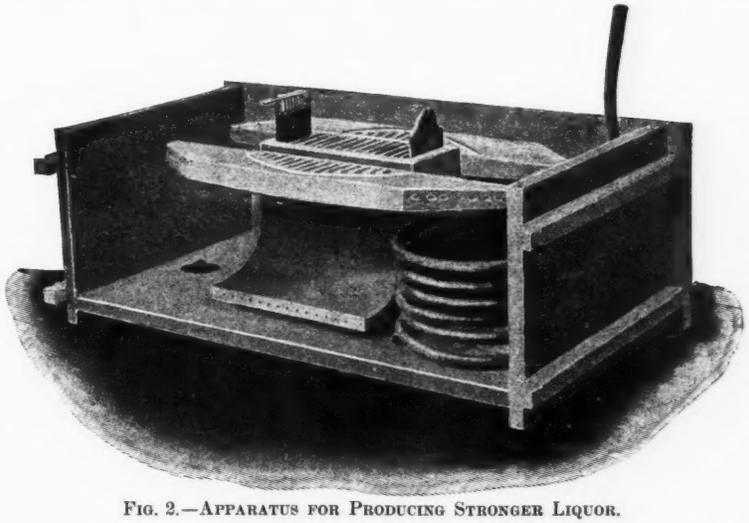


FIG. 2.—APPARATUS FOR PRODUCING STRONGER LIQUOR.

Fig. 2 represents a later apparatus, which produces a bleaching liquor some six times stronger than Fig. 1. Fig. 3 shows a special apparatus, producing the same bleaching liquor for use in steam laundries. All these machines are intended to be connected with the dynamos already in use for electric lighting.

SYSTEMS OF ELECTRIC TRANSMISSION AND DISTRIBUTION—IV.

BY CHARLES P. STEINMETZ.

(Concluded.)

Two distinctly different cases are possible:

(1). The 60-cycle alternating distribution as part of a general polyphase system of the same frequency, and derived therefrom by transformation. In this case best economy requires the use of a polyphase distribution system, to secure uniform load on the generating system.

(2). Where the alternating current for the 60-cycle distribution is generated directly by prime movers, or derived from a general system by motor generators, this limitation does not exist, and single-phase systems or unbalanced systems can be used as efficiently as balanced polyphase systems.

(1). Where, as part of a polyphase system, the distribution has to be polyphase, either three-phase or quarter-phase can be used. With the three-phase system, four wires are required for efficient distribution, and the lamps connected between the three outside wires and the fourth wire, or neutral, in Y-connection, while motors are connected to the three outside wires only, in delta connection. This system is very simple, requiring four wires only, and thus specially suited for secondary networks supplying lights and motors. But it requires dividing the lighting load between three circuits.

With the quarter-phase system the two phases are usually operated separately as two-wire, or, more commonly, three-wire single-phase systems, and brought together only where motors are used. Hence, the lamps have to be distributed between two circuits only, and each of these circuits is operated as a single-phase system. Thus, for lighting with incidental power, and where no extensive secondary network is used, but primary feeders and short secondary mains, and separate motor transformers, the quarter-phase system is frequently preferred, while for a general distribution for lighting and power from the same secondary mains, the three-phase system is better suited.

Occasionally a three-wire, quarter-phase system is used, employing a common return for both phases. This system obviously is far inferior in conductor material to the four-wire system, and permissible only with very low drops in the mains, since, due to the use of a common return for both phases, unbalancing effects occur between the phases, even at equal distribution of load. It has, however, the advantage that three-wire Edison continuous-current mains can be used for its operation previous to and until the increase of load warrants the change to continuous current, and under these conditions it is occasionally employed.

Where the alternating or polyphase distribution is a considerable part of the whole system and is of the same frequency, usually in the generators the same system is employed as in the distribution; that is, quarter-phase generators with quarter-phase distribution, except where the distance of transmission is so great as to make a three-phase system of transmission preferable, and the quarter-phase distribution system is derived then by changing in the step-down transformers from three-phase to quarter-phase.

(2). Superior to the above described polyphase systems in simplicity and thus reliability of operation, are systems of single-phase lighting with additional power wire. Such systems, however, are economically feasible only when operated from primary generators or motor generators, but not as part of a general polyphase system, except if they constitute such a small part of the general system that their single-phase nature does not seriously unbalance the general system.

Two such systems are feasible, first the monocyclic system of single-phase lighting, operating motors by means of an auxiliary phase supplying more or less wattless magnetizing currents, either from an auxiliary teaser coil on the generator, or from the third terminal of an induction or synchronous motor connected with its other two terminals to the single-phase mains, or by exchange currents between the motors, flowing from lightly loaded motors to heavily loaded or starting motors.

(3). The three-phase polycyclic system, in which on a three-phase generator all the lights are connected to one phase or between two terminals, and the voltage in the system controlled for constancy on this phase, while from the third terminal of the generator issues a power wire to motors only. With this arrangement, with load on the lighting phase, its voltage is relatively lower than that of the power wire, and thus the motors take more current from the third or power wire than from the lighting phase, or even return power into the lighting phase, thus equalizing the load more or less between the three phases.

Both of these systems have come into extensive use, the monocyclic for lighting with incidental power, the polycyclic system where power is more predominant and synchronous motors and converters may be required. Frequently, even these systems are used in an alternating distribution, constituting a part of a general polyphase system, by employing, for instance, three independent polycyclic systems of light and power distribution on the three phases, so as to balance the load on the generating station, while still retaining the advantages of single-phase lighting in each individual distribution system.

As secondary distribution, both systems, the monocyclic single-phase and the polycyclic three-phase, are four-wire systems with three-wire single-phase lighting mains, the outside conductors of which are used in combination with the fourth wire for motors.

VII.

CONSTANT POTENTIAL AND CONSTANT CURRENT.

Through many years the distribution of electric power was carried out exclusively by series connection of apparatus, mostly lights, in a constant-current circuit, first on the alternating, then the continuous-current system. Now the constant-current system with series connection of receiving apparatus is used only for exterior arc and occasionally incandescent lighting, and the constant-potential system reigns supreme.

The constant-potential system with parallel connection of receiving apparatus was introduced by Edison, together with the incandescent lamp, and has speedily displaced the constant-current system. The only reason that the constant-current system is still extensively used for arc lighting is to be found in the nature of the electric arc. The arc acts like a resistance which decreases with increase of current, and is, therefore, unstable on a constant-potential circuit (just as inversely a synchronous motor is unstable in a constant-current circuit), but requires for stable operation a constant-current circuit, or, at least, a circuit in which the voltage drops considerably with increase of current. Hence, to operate arc lamps from constant-potential mains, a device has to be inserted in series with the arc which decreases the voltage at the arc with increase of current; that is, a resistance with continuous current, a resistance or reactance with alternating current. Since this steadying resistance or impedance can be eliminated by the use of series connection in a constant-current circuit, constant current is used for arc lighting wherever the high voltage inherent to series connection is not objectionable; that is, for street lighting. At the same time thereby the advantage is gained to be able to reach distances which could not be reached by low-tension constant-potential continuous current. That, however, the high voltage is not the main advantage of series arc lighting is shown by the extensive introduction of constant-current alternating arc circuits, since, with alternating current, high voltage can be used also with constant-potential distribution.

Occasionally street incandescent lights are operated in the same manner, in series connection.

Except for exterior arc and incandescent lighting, series connection is used only in special applications of electric power, as electrochemical work of a nature requiring very low voltage, electrolytic work, where economical operation requires series connection of a number of electrolytic cells to reach practicable voltage, or in some kinds of electric furnace work.

A discussion followed, in which Messrs. Arthur Williams, Gano S. Dunn, Douglas Burnett and F. V. Henshaw participated.

Electric Railways

A new power-house has been built in Seattle, Wash., by the Seattle Electric Company, and when finished will have cost nearly $1,000,000.

Surveys have been begun on the proposed line for the new Lakeside & Western Electric Railway Company, of Ohio, which will begin in the eastern quarry section of Ottawa County, at Marblehead, and run through to Napoleon, and probably later on to Montpelier, Ind.

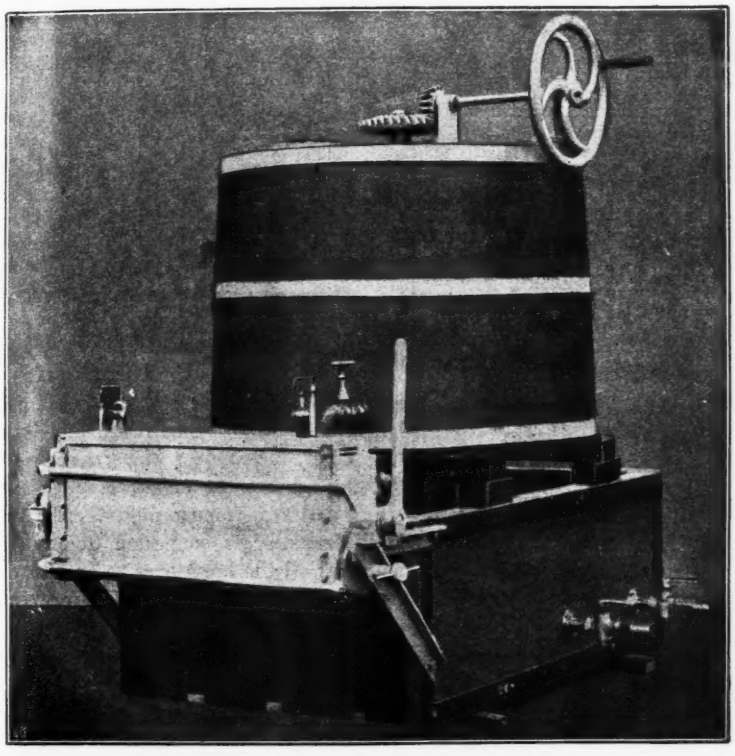


FIG. 3.—APPARATUS FOR STEAM LAUNDRIES.

An amendment to its charter has been filed by the Rapid Transit Subway Construction Company, of New York city, authorizing the company to purchase, sell and deal in all real estate or personal property useful in connection with the construction or operation of rapid transit railroads in the city of New York.

A syndicate of western capitalists is reported to be negotiating for the purchase of all the electric roads and power plants in San Josè, Cal., and reports from Baltimore state that a deal has been closed whereby the syndicate obtains control of the San Mateo & San Francisco Electric Railroad for $1,600,000.

German press reports state that the almost forgotten project for an electric railway between Rome and Naples has been revived and that two Neapolitan engineers have prepared new plans for the road, which, if undertaken, will run along the seashore through Cancello, Mondragone, Minturno, Formia, Fondi, Terracina and Cisterna to Rome.

Press reports from Ohio state that the capitalists who are back of the Little Miami Traction Company intend not only to construct an interurban line between Cincinnati and Springfield, but will run connecting systems to Columbus and Dayton, besides building several roads in the southern part of the state. There are said to be $5,000,000 back of the project.

Dr. Josè Maria Borgia, formerly consul-general to the United States from Ecuador, has recently been in the United States purchasing bridge material to be used in the completion of the Guayaquil & Quito Railroad. His purchases aggregated something over $2,000,000. The road in question runs to the rich goldfields in the vicinity of Quito.

The New York & Portchester Railroad Company will operate an electric street railway line 25 miles long extending from the Harlem River, New York city, through the Bronx to Portchester and the Connecticut line with a probable branch to Clason's Point on the East River. The line of the road will touch eight towns between Mt. Morris and Portchester.

Extensive new country territory will be made directly tributary to the retail trade of Cleveland, Ohio, by the contemplated construction and electric railway work in that city during the current year. Probably more than 300 such extensions will be constructed, bringing the inhabitants of territory within a radius of over 50 miles into touch with Cleveland, besides penetrating to northwestern Pennsylvania as far as Meadville.

Construction work is soon to be started on the new electric railway which will run from Coraopolis, Pa., to Monaca, a charter having been granted to the Coraopolis & Monaca Electric Railway Company. The road will be 12 miles in length and is expected to be in operation by the end of the year, paralleling the steam lines of the Pittsburgh & Lake Erie. The incorporators of the road are Henry Cooper, H. W. Klein, H. T. Dempsey, J. C. Whitla and C. I. McDonald.

National Electric Light Association.

Mr. C. O. Baker, Jr., master of transportation for the National Electric Light Association, announces that the rate of one fare and a third on the certificate plan has been granted to persons attending the twenty-fourth convention of this association, to be held at Niagara Falls, May 21, 22 and 23. The Trunk Line Association, the New England Passenger Association, the Central Passenger Association, the Southeastern Passenger Association and the Canadian lines have granted this reduced rate.

The time limit of these tickets, three days before and three days after the meeting, not including Sundays, will enable members who desire to do so to attend the dedicatory ceremonies of the Pan-American Exposition at Buffalo, which takes place on Monday, May 20, and also visit the exposition after the adjournment of the meeting.

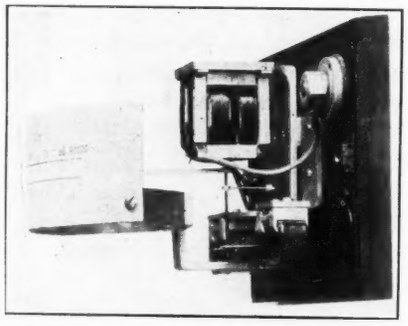
John I. Sabin President Chicago Telephone Company.

Telegraphic despatches from Chicago state that Mr. John I. Sabin, president of the Pacific Coast Telephone Company, has accepted the presidencies, also, of the Chicago Telephone Company and the Central Union Telephone Company, succeeding Presidents Clark and Jackson, respectively. Mr. Sabin is an able and highly successful telephone manager.

The two telephone companies, it is understood, will be operated as one system. Mr. Clark will become chairman of the board of directors of the Chicago company.

A Frequency Indicator, Power Factor Indicator, Wave Form Indicator, and the Thomson Load Meter.

The following brief descriptions refer to some interesting new apparatus exhibited by Messrs. Charles E. Clarke and



FREQUENCY INDICATOR.

Caryl D. Haskins at the recent *conversazione* of the American Institute of Electrical Engineers.

FREQUENCY INDICATOR.

The frequency indicator is a direct-reading instrument showing the number of cycles on the circuit to which it is attached. It consists of two fixed coils making a right angle with each other and a small piece of sheet iron fastened to a shaft, which moves between two jewels without springs or other controlling force, moving a pointer over a scale marked in cycles. In series with one of the coils is inductance and in series with the other resistance. When the frequency of a circuit changes the ratio of the two currents in the coils is changed also. The iron blade takes up a position depending on the relative ampere-turns in the two circuits and this changes the position of its pointer on the scale. When the voltage of the line varies both currents vary in the same proportion and therefore the instrument is not affected by change of pressure.

POWER FACTOR INDICATOR.

The power factor indicator is constructed on the principle that, in a balanced two or three-phase system, the power factor changes with the ratio of watts as found in the two-wattmeter method of measuring the power of the system. This principle has been applied by the General Electric Company in various ways in the construction of power factor indicators. The one on exhibition had a fixed current coil and two potential coils, the latter being on the same shaft, making an angle with each other. The current is led into the movable coils by leads, the controlling force of which is negligible in comparison with that between the fixed coils and the movable coils when the instrument is connected to a circuit. The scale of the instrument is found by actual calibration, that on the instrument exhibited being adapted to rotary converter work with a power factor of one in the middle of the scale and a power factor of 90 per cent lagging at one end of the scale and 90 per cent leading at the other.

WAVE FORM INDICATOR.

The apparatus exhibited at the *conversazione* for determining the wave form of electro-motive forces or currents has been in nearly constant use at the works of the General Electric Company for a number of years. It consists of a contact disk

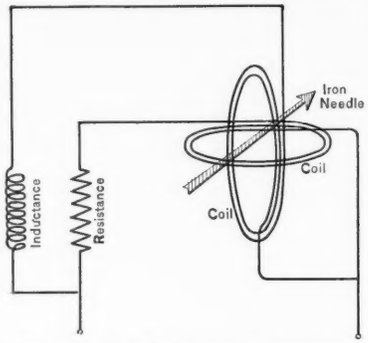


DIAGRAM OF FREQUENCY INDICATOR.

and a small synchronous four-pole motor, to the shaft of which is fixed a revolving brush which slides over the edge of the disk. The motor is arranged to run without hunting or oscillation. Formerly the disk was attached to the shaft of the generators to be tested but the great number of poles of large modern machines made it desirable to have an apparatus independent of the angle of one pair of poles. As constructed it is also much more flexible for general use.

The contact device consists of a number

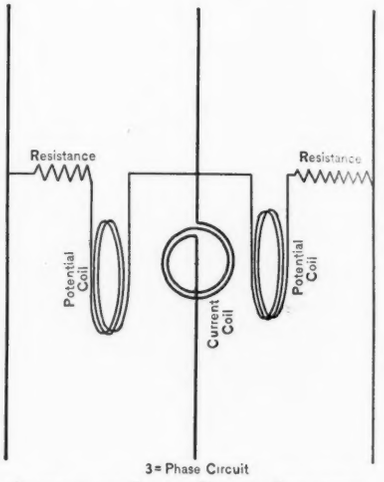
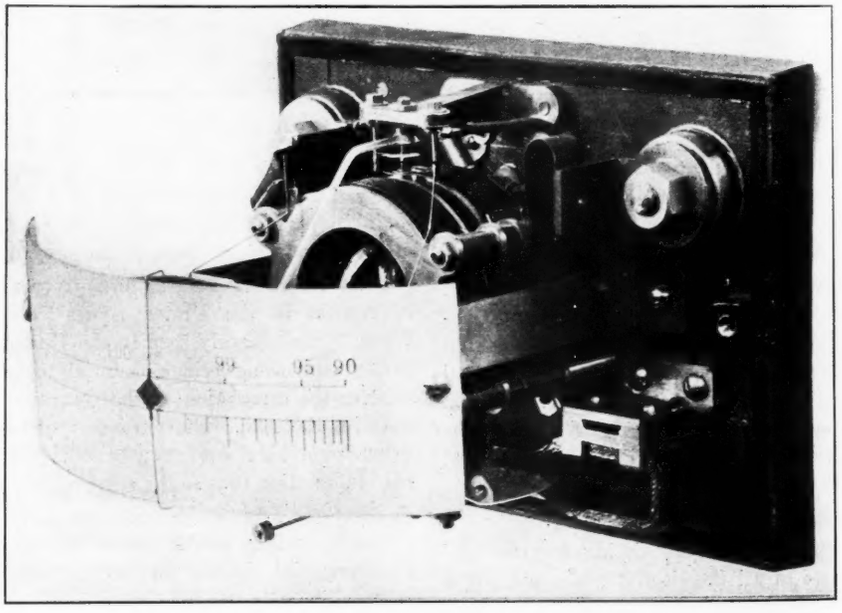


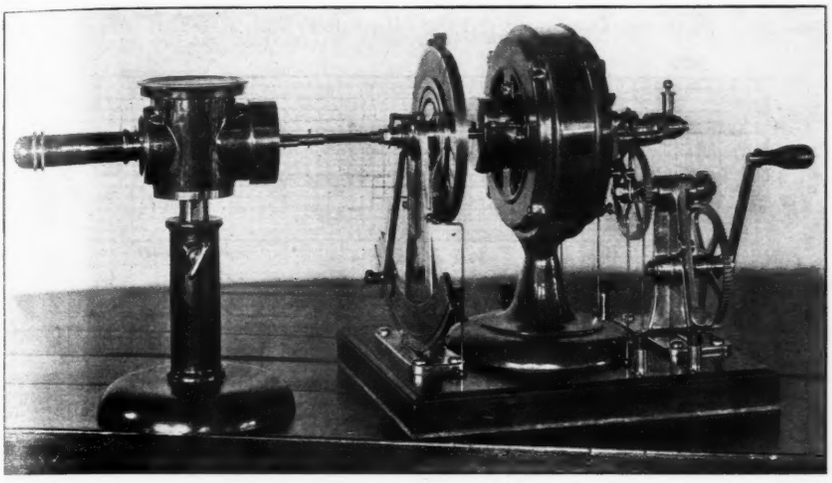
DIAGRAM OF POWER FACTOR INDICATOR.

of metallic segments on the edge of a hard-rubber disk. There are four large and four smaller segments, each pair consisting of one small and one large segment, the number of pairs corresponding to the number of pairs of poles of the small synchronous motor. All the small segments are connected to one terminal and all the large ones to another. When the revolving brush slides over a small segment it connects a condenser directly to the potential difference to be measured, permitting current to flow into the condenser. At the instant at which the brush



POWER FACTOR INDICATOR.

leaves a small segment it leaves the condenser charged with the instantaneous potential difference to be measured, permitting current to flow into the condenser. At the instant at which the brush leaves a small segment it leaves the condenser charged with the instantaneous potential difference which the circuit had at that instant. The brush then sliding over the large segment closes a circuit consisting of the charged condenser and a direct-current voltmeter and causes the condenser to discharge through the instrument. These charges and discharges occur four times per revolution and are, with the instrument actually used, at ordinary commercial frequencies, sufficiently rapid to produce a steady deflection. To the hard-rubber disk is fastened a finger which can be revolved by hand, and, by means of a scale, moved every five degrees so as to enable the operator to read off equidistant instantaneous potential differences. A change of condenser capacity or resistance of the instrument does not affect the relative values indicated as the capacity and resistance are not altered during the test. The deflection of the voltmeter is actually proportional to the instantaneous voltage, as damping, etc., does not affect the steady deflection.



WAVE FORM METER.

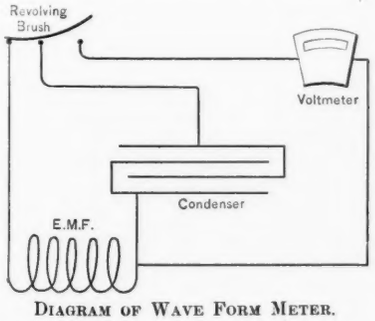


DIAGRAM OF WAVE FORM METER.

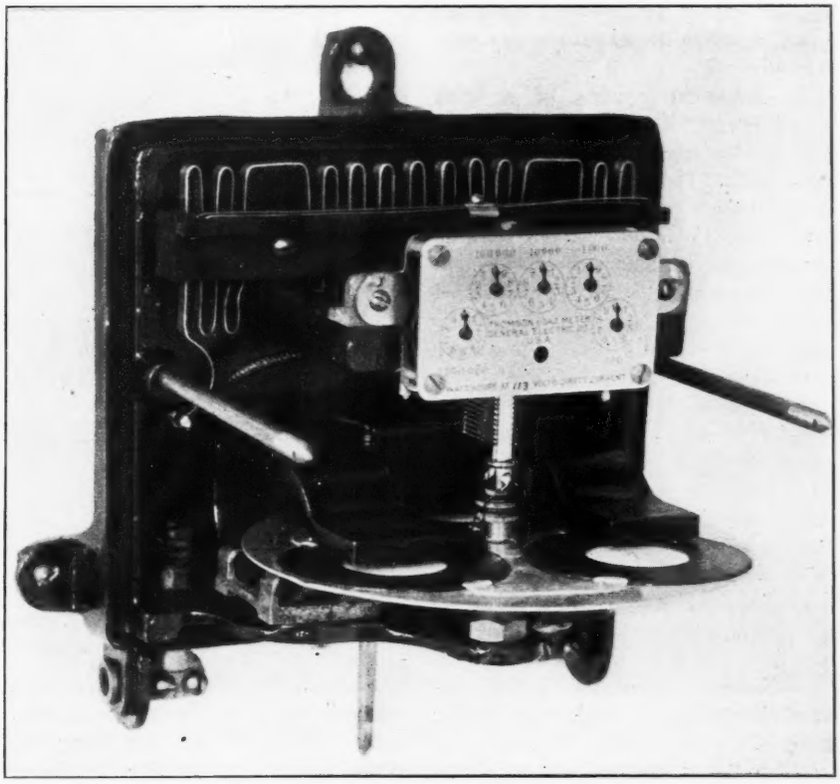
The instrument is said to have given much satisfaction and apparatus made like the model has been in use in colleges, factories and stations.

THOMSON LOAD METER.

The Thomson load meter is a recording integrating device for the commercial measurement of current delivered to continuous-current lighting and power loads. Being devised for use upon constant-potential systems of close regulation, it is calibrated in watt-hours. The speed of the meter, however, bears direct ratio to the current traversing its coils.

The meter consists in its principal element of an aluminum disk mounted upon a vertical shaft, engaging at the top with a recording train and the lower end of the shaft resting upon an appropriate jewel. The aluminum disk is free to rotate between the jaws of permanent magnets, structurally similar to those used upon other forms of meters. Upon the aluminum disk are mounted three pancake coils, which constitute an armature, the energy of which is derived through a commutator carried on a shaft or spindle. The armature energy is derived around a fixed resistance contained within the meter, the armature or revolving element thus being in shunt to the resistance. The three pancake coils constituting the armature and physically fixed to the disk produce torque as in an ordinary motor, the permanent magnets constituting the fields. The same permanent magnets constitute the magnet element of the drag or load, which consists of Foucault currents generated in the revolving disk.

Friction compensation for light-load operation is provided for by replacing a small electromagnet in such a position as to bring the outer edge of the disk within its jaws. The drag of this magnet increases as the load increases, because the winding is in series with the meter load. The drag is thus less at light loads than at heavy loads, which offsets the effect of the friction.



THOMSON LOAD METER.

THE CLEVELAND & CHAGRIN FALLS RAILROAD'S STORAGE BATTERY SUBSTATION.

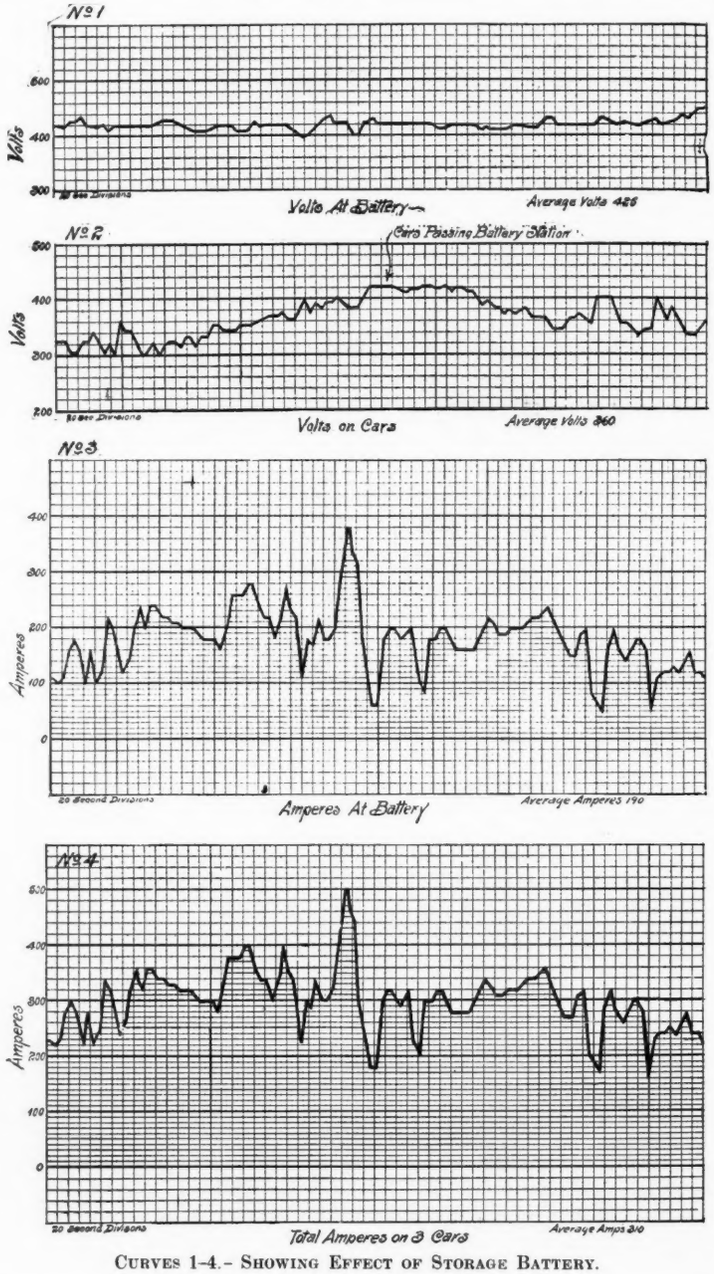
BY R. L. PALMER.

In the following description it is not my intention to make statements in any degree technical. My desire is to make a plain statement of facts as I have found them in the storage battery installation recently placed on the Cleveland & Chagrin Falls Electric Railroad. As this is practically a new industry, I hope the few remarks which I make will be of assistance to other roads who have the troubles to contend with which we had before we installed our battery. The length of the road from Cleveland to Chagrin Falls is approximately 14 miles, the western terminus being at Woodland Hills. The battery is situated 11 miles west of Chagrin Falls and 3 miles east of Cleveland. Before installing the battery, the voltage at the western terminal and for six miles east was very low at times, especially if it became necessary to do any extra work. It was also found almost impossible to maintain the regular schedule on this end of the road, and if anything out of the ordinary happened it was impossible to get satisfactory service at all.

The substation consists of a brick building 30 by 60 feet, which is situated about 150 feet from the track at the above-named point. The building is roofed with slate, and the floor of the battery room is paved with brick. The battery rests on stringers four by four inches, which, in turn, rest on piers built at intervals of five feet the whole length of the battery room. In the front of the building there is partitioned off a room, extending the whole width of the building and 10 feet deep, for the switchboard apparatus. The floor of this room is of wood.

The battery consists of 220 cells of the Willard standard type, of 400-ampere-hour capacity, the elements of which are placed in lead-lined tanks large enough to enable the capacity to be increased to 600 ampere-hours. The tanks are insulated from the stringers by eight petticoat glass insulators each, one insulator near each corner of the tank, with another tier resting on top of the lower ones. The plates are burned to heavy lead bus-bars, which are reinforced wherever it is necessary to lead from one group of cells to another. The leads are of bare copper, and are covered with lead at all places where the copper is liable to be reached by the acid fumes.

The battery has a momentary discharge rate of 400 amperes, allowing for extreme cases of fluctuation as high as 900, at which point the circuit-breaker at the battery station is set. A very good idea of the appearance of the substation can be had from the accompanying illustration. There are also presented several curves, which were taken simultaneously during a test made on the battery to ascertain its behavior under maximum conditions of load. While this test was being made three cars were in operation at a distance apart of about 500 feet, starting at the western end of the line near a point where the voltage had always been the lowest.

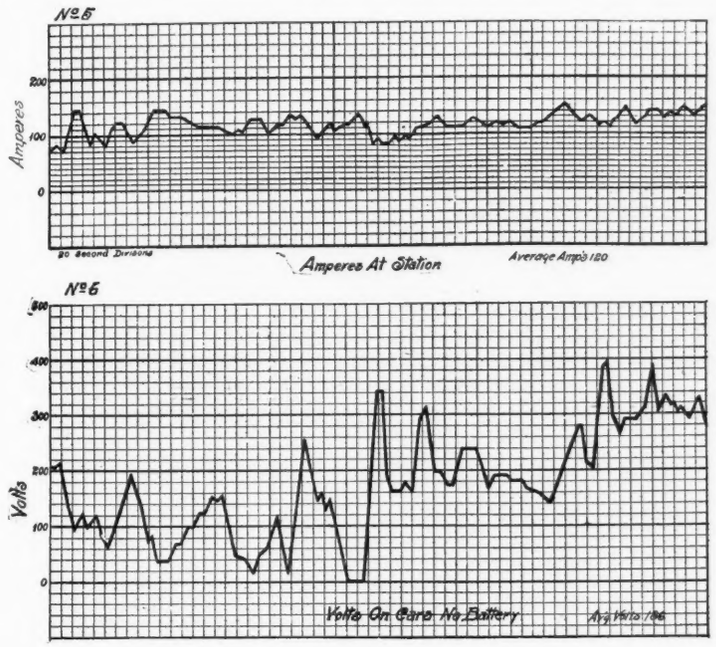


CURVES 1–4.– SHOWING EFFECT OF STORAGE BATTERY.

Curve No. 1 shows the voltage as taken at the battery while operating under the above conditions, the average being 425 volts. Curve No. 2 shows the average voltage taken on the cars. In the centre of curve No. 2 an arrow is shown to designate the point at which the cars passed the battery station, the voltage at this point being equal to that of the battery. Curve No. 3 shows the ampere readings taken at the battery station or that part of the current that was supplied from the same. Curve No. 4 shows the total number of amperes taken by the three cars. Curve No. 5 shows the amperes furnished by the station, which, as stated above, was situated 11 miles east of the battery. For the sake of comparison, I have introduced curve No. 6, which shows the voltage which would have been obtained had it been possible to operate the above-named cars from the station without the use of

the battery. At a point near the centre it will be observed that there would have been no current at all; in fact, the voltage would have been many volts worse than nothing. The average volts, as shown on this curve, are approximately 186.

The average voltage maintained after the battery was installed was 360, for a distance of nearly six miles. As I stated before, these tests were made under maximum conditions of load. Under the regular schedule the voltage at a point near the battery is maintained at 450 volts and over.



CURVES 5 AND 6.—SHOWING EFFECT OF STORAGE BATTERY.

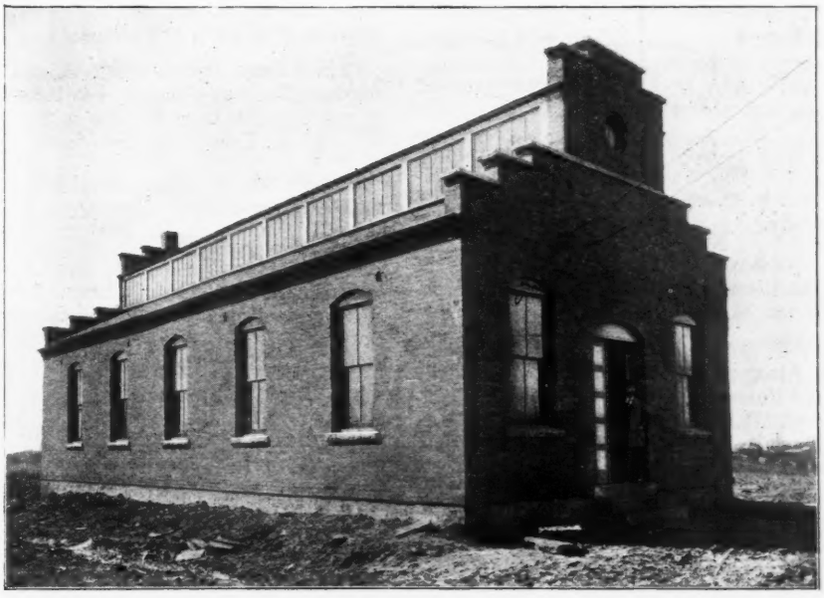
The results secured, as stated above, have been with an expenditure of less than one-third the cost of copper necessary to do the same work while operating under the regular schedule. To accomplish what the battery does under maximum conditions would mean an outlay of copper considerably in excess of this. The battery not only pulled us out of a very bad hole, but we found it to be useful in various other ways. For instance, it has been used to operate the whole line on several occasions, the power-house having been shut down at 8.30 P. M., the battery carrying the whole load until 11 o'clock. It is also used to maintain lights at different points along the line, and for switching cars at or near the power-house at Chagrin Falls.

In conclusion, I wish to say that the battery has given such perfect satisfaction that we have contracted with the manufacturers for a second battery of 265 cells, to be placed at a point 14 miles east of our power station on the eastern division of our road. The battery was manufactured by the firm of Sipe & Sigler, Cleveland, Ohio.

A New Type of Direct-Reading Ohmmeter.

The instrument shown in the accompanying illustration is a direct-reading ohmmeter intended for very rapid work in measuring the resistance of coils and instruments, and for such other uses as will readily suggest themselves to any one who is accustomed to the use of electrical measuring instruments. It is manufactured by the Myers Break Finder Company, Syracuse, N. Y. The instrument has four binding connections, to two of which are connected the terminals of any convenient source of direct current, such as a dry battery, while to the other two are connected the terminals leading to the resistance to be measured. In the middle of the dial is a thumb-nut attached to a needle sweeping over the scale and geared to a magnetic needle enclosed in a small case visible through the hole in the dial. By turning the thumb-nut to the number thought to approximate the resistance to be measured and pressing the button a deflection of the magnetic needle will generally be induced; the point is then turned further in the indicated direction and the button again pressed. After two or three trials a point is found at which pressure upon the button causes no deflection. The needle then points to a number indicating the ohms resistance of the circuit under test. The instrument is made in sizes ranging between five ohms and 2,000 ohms total range.

A NEW TYPE OF OHMMETER.



STORAGE BATTERY SUBSTATION OF THE CLEVELAND & CHAGRIN FALLS R. R.

An electric light plant is to be erected in Covington, La., by the Covington & St. Tammany Ice Manufacturing Company, Limited.

Corporation News

CINCINNATI, OHIO—Sterling Electrical Manufacturing Company. $15,000.

KANSAS CITY, MO.—Union Construction Company. $1,000,000. To build railways in western states.

BALTIMORE, MD. — Baltimore Auto-Traction Company. $3,000, with permission to increase to $300,000.

SCOTIA, N. Y.—Scotia Traction Company. $30,000. Directors: G. Lynch, W. H. Delaney, H. V. Minderse.

FRANKFORT, KY.—People's Water and Electric Light Company. $20,000. L. I. Crawford and others, incorporators.

CHICAGO, ILL.—Diamond Car Line. $25,000. Incorporators: W. K. Sharpe, J. L. McKittrick and M. K. Northan.

ROCHESTER, N. Y.—Rochester Steam Motor Works. $100,000. Directors: F. W. Zimmer, W. T. Fox and G. B. Watkins.

NEW YORK, N. Y.—National Battery Company. $500,000. Incorporators: W. B. Greeley, C. A. Wendell and others.

CLYDE, WAYNE COUNTY, N. Y.—Lux Electric Light, Heat and Power Company. $50,000. Directors: C. A., D. E., and C. F. Lux.

HARTFORD, CT.—Hartford Electrical Supply Company. $1,000. Incorporators: C. C. Cook, F. W. Bartlett and others.

BRAZIL, IND.—Brazil Brewing, Ice and Power Company. $60,000. Incorporators: P. D. C. Ball, William Roberts and others.

HENRIETTA, TEX. — Henrietta Light and Power Company. $5,000. Incorporators: G. A. Jackson, F. P. Neville and others.

AUGUSTA, ME.—New Era Automobile and Rubber Company. $1,000,000. President, William Halkyard; treasurer, W. G. Kendall.

WORCESTER, MASS.—Crompton Motor Carriage Works. $5,000. Incorporators: C. Crompton, G. H. Kimble and C. A. Pratt.

WEST MILTON, OHIO—The Progress Telephone and Telegraph Company has increased its capital stock from $10,000 to $30,000.

DANVILLE, VA.—Standard Electric Company. $5,000. James G. Penn, president, and J. N. Williams, secretary and treasurer.

ST. LOUIS, MO.—Ford Automobile Boiler Cleaner Company. $200,000. Incorporators: G. R. Ford, A. H. Danforth and F. F. Rush.

CAMDEN, N. J.—Church Automobile and Specialty Company. $125,000. Incorporators: W. A. Church, H. T. Jones and J. H. Giles.

MICHIGAN CITY, IND.—Indiana Transportation Company. $33,000. Incorporators: George G. Oliver, J. N. Campbell and O. E. Parks.

SCOTTSBURG, IND. — New Telephone Company. $5,000. Officers: M. Storen, president; F. H. Park, secretary; J. W. Martin, treasurer.

SHERMAN, TEX.—Grayson County Telephone Company. $150,000. Incorporators: F. B. McElroy, W. A. Armstrong and others.

NEW YORK CITY, N. Y.—Postal District Messenger Company. $10,000. Incorporators: W. H. Baker, C. P. Brush and J. O. Stevens.

TAYLORSVILLE, IND.—Taylorsville Telephone Company. $2,000. Incorporators: Seneca S. Drybread, B. W. Chamber and E. McSweeney.

CHICAGO, ILL.—Advance Electric and Telephone Company. $15,000. Incorporators: V. H. Messenger, H. H. Hansen and G. A. Thompson.

STONE CITY, IND.—Stone City Light, Heat and Power Company. $100,000. Incorporators: T. F. Barrett, E. McSweeney and J. E. Boruff.

CINCINNATI, OHIO — Cincinnati & Lebanon Railroad Company. $10,000. Incorporators: J. I. Stephenson, F. C. Marcom, F. Munroe and others.

CLEVELAND, OHIO — The Cleveland Southern Railway Company has increased its capital stock from $10,000 to $1,000,000. W. H. Lamprecht, president.

HARPSWELL, ME.—Harpswell & Brunswick Electric Railroad Company. $100,000. Directors: C. B. Harmon, E. A. Hubbard, J. O. Bradbury and others.

HAZELRIGG, BOONE COUNTY, IND.—Hazelrigg Cooperative Telephone Company. $500,000. Incorporators: D. E. Sanders, W. Berry and G. A. Randell.

NEW YORK, N. Y.—W. N. Thayer Company. $5,000. To construct electrical machinery. Directors: W. N. Thayer, G. N. Warner and E. G. Bernard.

LORAIN, OHIO—Lorain Steel Motor Company. $600,000. To manufacture electric motors. Incorporators: A. G. Brown, E. W. Ulmer and E. T. Gagoffin.

EDWARDSVILLE, ILL. — Edwardsville, Collinsville & St. Louis Electric Railway. $50,000. Incorporators: E. C. Springer, C. Boeschenstein, J. A. Day and others.

ELLENVILLE, N. Y. — Ellenville & Kingston Railroad Company. $300,000. Directors: T. H. Fowler, T. B. Childs, G. B. Schley, C. L. Hoyt, A. S. Roe and others.

NEW YORK, N. Y.—Merritt & Lockwood, Incorporated. $10,000. To deal in electrical supplies. Directors: T. F. Merritt, E. F. and Elizabeth M. Lockwood.

ORANGE, N. J. — American Tractor Company. $200,000. To build steam trucks under W. E. Gibbs's patents. Incorporators: Herbert Knight, D. J. Newland and others.

HEMPSTEAD, L. I.—Long Island Traction Company. $20,000. To operate automobile passenger conveyances. Directors: W. P. Miller, A. D. Young, L. C. Johnston and others.

ATTICA, N. Y.—Attica Natural Gas, Water and Electric Company. $250,000. Officers: E. H. Lawall, president; Dr. E. B. Long, vice-president; H. C. Smythe, secretary and treasurer.

KANSAS CITY, MO.—Southwestern Mining and Development Company, of New York. $1,250,000. Incorporators: W. P. Brown, C. H. Welch, G. A. Beaton, J. B. Leake and J. J. Welch.

DEPOSIT, N. Y.—The Deposit Electric Company at a special meeting recently increased its directors from four to five, and its capital stock from $24,000 to $100,000. Also voted to purchase the Deposit Light and Power Company.

TONAWANDA, N. Y.—The Tonawanda Gas Light Company, the Standard Gas Company and the Tonawanda Lighting Company have been consolidated under the name of the Niagara Light, Heat and Power Company. Capital stock $200,000. Directors: Frederick S. Wende, J. W. Fisher, G. P. Smith, H. S. Wende and E. R. Ford.

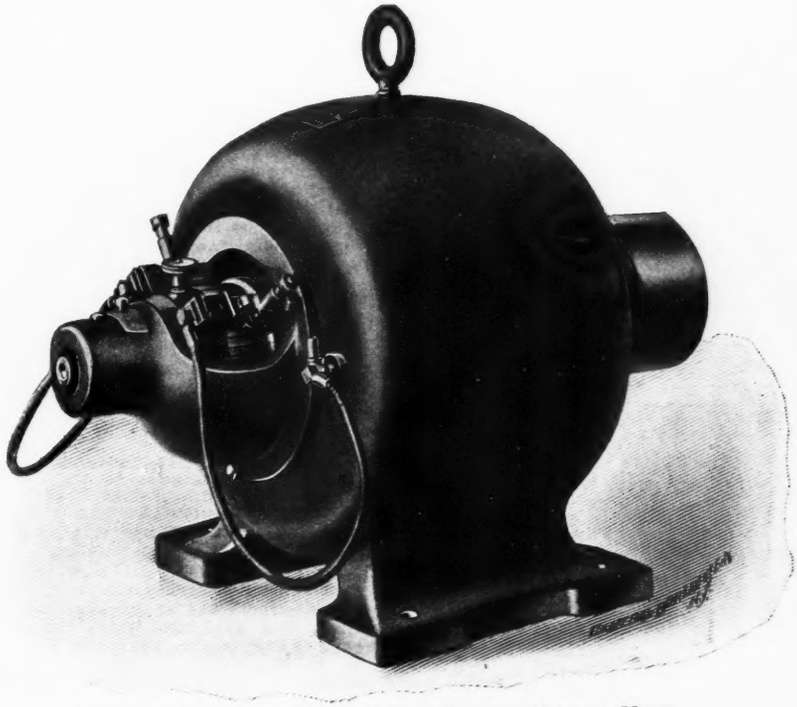
COLUMBUS, OHIO—Columbus, London & Springfield Railway Company. $250,000. Officers: A. G. Grant, president; A. E. Appleyard, vice-president; E. Tompkins, secretary; J. G. Webb, treasurer; H. A. Fisher, general manager. This company has recently absorbed the Grove City & Green Lawn Electric Railway Company.

WHEELING, W. VA.—Wheeling & Elm Grove Railway Company. This company in a consolidation of the Suburban Light, Heat and Power Company, Suburban Railway, Wheeling Park Association, Suburban Light and Water Company, and the Wheeling & Elm Grove Railway Company. Bonds will be issued to the amount of $1,250,000. Anton Reymann is president.

LONDON, ENGLAND — Cook's Patent Tramway System, Ltd.; $25,000; incorporators: H. J. Cook and M. Ehrenfeldt. H. Ingram, Ltd.; $400,000. Hedges, MacKrell & Company, Ltd.; $5,000. British Electrical Manufacturing Company, Ltd.; $50,000. Pritchetts & Gold, Ltd.; $200,000; to manufacture storage batteries and act as electrical engineers. Okonite Company, Ltd.; $600,000; directors: F. C. Jones, H. Durant Cheever, Willard L. Candee, J. H. Cheever and W. F. Gaston.

Semi-Enclosed, Slow-Speed, Direct-Current Motor.

It was the attempt of the designers of the semi-enclosed type of slow-speed direct-current motor illustrated in the accompanying engraving to produce a machine that should unite with unusually high efficiency great solidity of construction and sturdiness of design, enabling it to run long periods without any attention whatever. The motor, as the illustration clearly shows, is of a four-pole type, very solidly and strongly made and interchangeable for floor, wall, or ceiling work. All parts liable to injury are enclosed, while the brushes, of the radial type, are easily accessible for adjustment when this is necessary. The machine is claimed to have practically no external magnetic field, and it is also said by the makers, Messrs. Palmer & Olson, New York, that it will run at full load for long periods without noticeable rise of temperature.



A New Type of Semi-Enclosed Direct-Current Electric Motor.

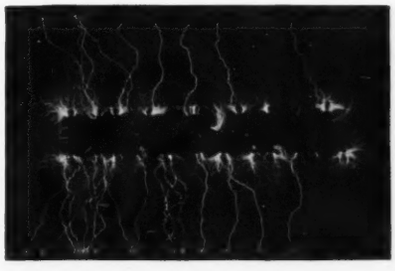
Mica Mining Illustrated.

Messrs. Eugene Munsell & Company, of New York, Chicago, and Ottawa, Canada, have recently published a booklet consisting simply of reproductions of a series of highly interesting photographs showing mica mining in India, Canada, and North Carolina. The illustrations speak for themselves, and make the pamphlet a trade publication of unique interest.

The Lightning Sign.

Mr. C. E. Spinner, of Pittsburgh, is the inventor of the remarkable electric sign, an illustration of which is shown herewith. The sign has been developed under the supervision of Mr. Paul M. Lincoln, resident electrician of the Niagara Falls Power Company, at Niagara Falls, N. Y.

The apparatus consists of a large sheet of plate glass making the front of the sign, the sides of which are also of glass, and a back of tinfoil. Between the glass and the tinfoil is arranged a zigzag network of wires which are connected to one polarity of the circuit, the tinfoil being connected to the other. With a pressure of 5,000 volts or upward most powerful effects are caused to appear, every part of the machine becomes luminous with blue light, and at high pressures heavy sparks, closely resembling genuine lightning flashes, run over the surface of the glass.



A New Variety of Electric Sign.

LITERARY.

The *Scottish Electrician,* published at Edinburgh, a new electrical monthly, has made its appearance. Its announcement that it is "the only electrical journal out of London" seems lacking in some particulars, but we let that pass. The journal seems intended for home consumption, being devoted largely to local affairs, but its tone is good and its typographical appearance less ugly than that of the average British technical paper.

The *Century Magazine* for June and July will contain a brief summary of Mr. Grover Cleveland's two recent lectures on the Venezuela Affair, the lectures having been especially copyrighted. They are said to constitute Mr. Cleveland's most important contribution to history.

The *Popular Science Monthly* for April contains several scientific articles of more than usual interest, including one by Mr. Frederick Emory, Chief of the Bureau of Foreign Commerce, who describes the great increase in the export trade of the United States.

Hamilton Drummond's successful novel, "The King's Pawn," is in its third edition, though only one month from the press. The book is full of thrilling adventure and keen interest, being a good example of historical fiction. It is published by Doubleday, Page & Company, New York.

The April *Century,* among other articles of great interest, contains a contribution by Walden Fawcett, which is entitled "The Transportation of Iron," and another by Mary Gay Humphreys on "Trade Unions in Japan."

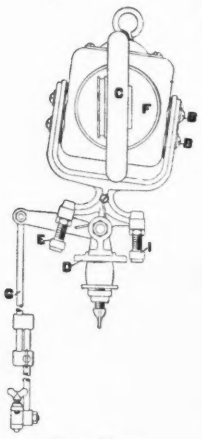
Scribner's Magazine for May contains an article by Mr. Walter Wyckoff entitled "The Workers." Other stories of equal interest and importance will appear and the magazine will be copiously illustrated as usual.

A Higher Corporation Tax Rate in Cleveland, Ohio.

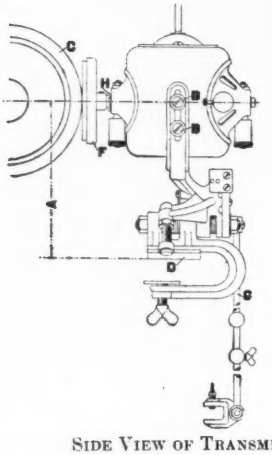
Mayor Tom L. Johnson, of Cleveland, Ohio, is reported to have formulated a plan by which he expects to readjust taxation in that city. The decennial appraisers have been appointed by Mayor Johnson to tabulate the tax valuations from the city's tax maps, so that when the Mayor learns the actual money value of the various corporations, with particular reference to street and other railroads, he may be able to go before the city board of equalization and demand that the corporations be made to pay taxes which he believes would be equitable.

A Sewing Machine Transmitter.

The method of operating sewing machines by electric motors, illustrated in the accompanying engravings, is known as the transmitter method and possesses advantages in that it requires no rheostat or belting and that it can be applied to any sewing machine without mutilation of the latter. The motor does not run continuously but only with the operation of the machine, and takes power in proportion to the amount of work being done. Instantaneous stop "on the stitch" is also possible without the use of a brake. The variable speed is said to be under perfect control of the operator and may be varied up to 2,000 stitches per minute, permitting an immediate start at full speed or the moving of the needle a fraction of an inch at a time when desired.



End View.



Side View of Transmitter.

Sewing Machine Transmitter.

With the apparatus here illustrated, which is made by the Paragon Fan and Motor Company, New York, the sewing machine head is positively driven at all times, variable speed being obtained by a variable leverage, so that no matter how heavy the work is the machine may be driven at a low speed and successfully handle it. The operation of the device is so simple that it may readily be understood from the accompanying illustrations without further description.

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 220 bid and 224 asked, showing a loss of 6 points. Metropolitan Railway, of New York, closed at 173⅞ bid and 174 asked, showing a gain of 5⅜ points. Brooklyn Rapid Transit closed at 86½ bid and 86⅞ asked, showing a gain of 3⅛ points for the week. Third Avenue Railroad closed at 126¼ bid and 127 asked, showing a gain of 4¼ points. Manhattan Railway, of New York, closed at 129⅞ bid and 130 asked, showing a gain of 1¼ points over last week.

On the Boston exchange, American Telephone and Telegraph closed the week at 175 bid and 176½ asked, showing a gain of 4 points. Erie Telephone closed at 59 bid and 60 asked, indicating a loss of 1½ points.

On the Philadelphia exchange, Electric Company of America closed the week at 9¼ bid and 9½ asked, indicating a gain of ⅝ point. Union Traction closed at 31⅜ bid and 31½ asked, showing a gain of ⅛ point.

On the curb, or outside market, in New York, Electric Vehicle closed at 12½ bid and 13¼ asked, indicating no change in the bid price. Electric Boat closed at 19 bid and 21 asked, showing a loss of 1 point. Consolidated Equipment closed at 7¼ bid and 8 asked, indicating a loss of ⅛ point for the week.

Wall street, April 20.

Industrial Notes

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., has established a branch office in Chicago, located at 403 Fisher Building. Mr. C. H. Norwood is the company's representative in that city.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., reports the electrical supply business to be very active. One day last week an order for immediate shipment of 350 Gutman wattmeters was received, which was certainly a good day's record for one item.

THE DRIVER-HARRIS WIRE COMPANY, of Newark, N. J., is making a new resistance wire which is said to be of particular value to makers of measuring instruments, possessing a resistance 33 times that of copper and a temperature coefficient of 0.00002; its thermo-electric effect against copper is very low. This wire is designated by the company as "S. B." resistance wire.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is compiling a new fan motor catalogue for this season, in which it has listed Falcon, Diehl, General Electric, Tuerk, Westinghouse, Central, Empire and Battery fan motors. A copy of this catalogue will be sent to any one upon application. This company has also a new complimentary order book which it will send, post-paid, to any customer who so desires.

THE BUNNELL TELEGRAPHIC AND ELECTRICAL COMPANY, 110 to 116 Beekman street, New York, N. Y., has issued its catalogue No. 10. The book contains 220 pages and an index, and deals with every sort of small electrical apparatus from advance burners and annunciators to battery zincs. The apparatus which the company handles is manufactured under the patents of the late Jesse H. Bunnell, and is well known throughout the country. The book is a veritable compendium of electrical supplies and contains nearly 1,000 illustrations.

THE NEW LARGE MACHINE SHOPS now being erected at Elizabethport, N. J., for the Central Railroad of New Jersey, for which Mr. Geo. Hill is consulting engineer, will be equipped exclusively with the well-known Lundell power apparatus manufactured by the Sprague Electric Company. The equipment will consist of three 100-kilowatt generators of 240 volts and 250 revolutions per minute, direct-connected to Ball & Wood engines, and 75 motors of various sizes for driving the machine tools. The manufacturer states that the Lundell generators and motors have long had the distinction of being of the very highest degree of excellence in efficiency, durability and mechanical construction. All of the motors and one generator are booked for delivery in June and the other two generators will be delivered in July.

J. H. BUNNELL & COMPANY'S NEW FACTORY. J. H. Bunnell & Company, 20 Park place, New York city, recently issued its new catalogue No. 18. The catalogue contains a complete description of the different lines of electrical supplies and equipments handled by the company, and is handsomely illustrated. The company announces that it is rapidly completing its new factory, where it will have largely increased floor space, the factory will be equipped with all modern facilities for the manufacture of high-grade telegraph instruments and other electrical appliances. The company is at present installing the most approved modern machinery for the manufacture of such apparatus, which, it states, will be placed on the market in large quantities at the lowest cost. The new factory will make it possible for the company promptly to fill and deliver all orders on apparatus handled in its line.